Heating and Ventilating

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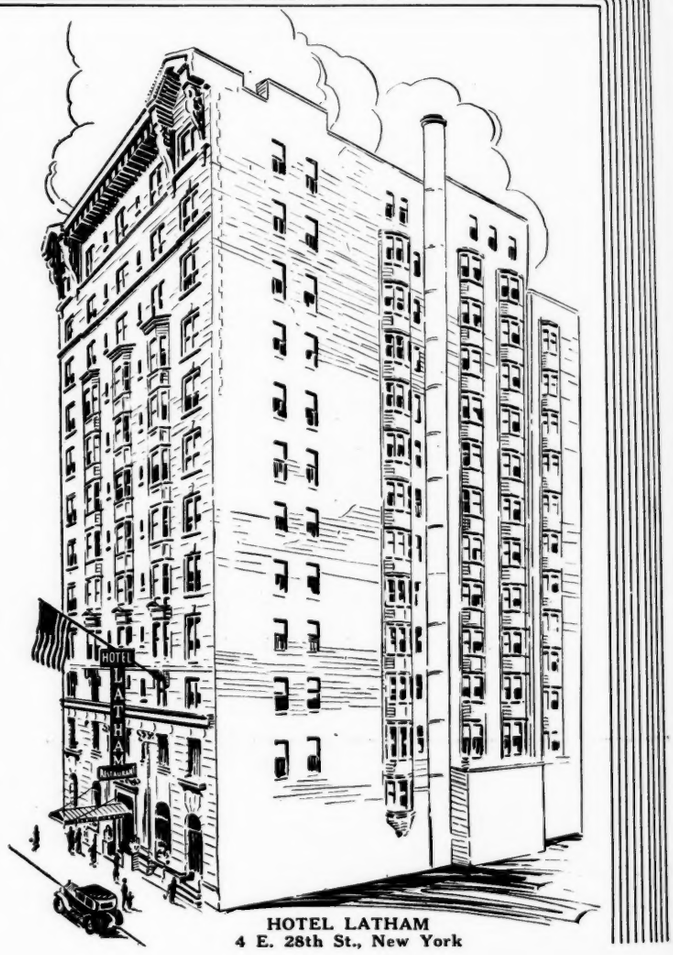

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EDITORIALS

This Year's Law Making

IF there is already an excess of laws, as is so often alleged, then the heating and ventilating industry is faring well in legislative matters this year. The record in most of the cases of proposed enactments is "no action."

In New York, there was an even break. Two proposals of interest were up for its consideration, and in the one case no action was taken while in the other the proposed act was passed. The legislature adjourned without passing the act for the registration of contractors, but it passed the Mastick bill for amending the school ventilation law. As we go to press the Governor's action on signing this bill is unknown. This is the same bill which passed the legislature last year and was vetoed by the Governor. It permits "adequate ventilation" instead of the use of 30 cu. ft. per person, as the present law requires.

The situation in Congress regarding the proposed home loan bank bill is not encouraging. It seems to have been side-tracked and there is reason to surmise that "no action" will be written on the record.

At the instance of architectural organizations it was proposed that Congress amend the public building laws to make mandatory the preparation of plans under the supervision of independently practicing architects instead of employed architects under the Supervising Architect. During hearings on this bill the government department objected to the measure on the grounds that the cost to the government would be increased. Latest reports are to the effect that the bill cannot pass in the face of the opposition.

In the several state legislatures still in session, no movements for drastic or important legislation affecting this industry are known, and as most of these sessions are approaching a close there appears little likelihood that enactments of importance will pass.

In several cities movements looking toward building code enactments or revisions are in various stages. These usually affect us directly but are necessarily slow in developing.

On the whole, this law-making season is of little direct importance to this industry. The most important definite act is that in New York, and the final result there is still in doubt.

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Ice Cooling

IN these columns we have previously called attention to the fact that the use of ice for air cooling has some favorable characteristics. We are naturally pleased to note that others are becoming converted to this view. A recent letter from a management corporation contained an analysis of the situation which showed careful study and arrived at the conclusion that ice is well worth experimenting with in this connection. As we have stated before, how far it will progress in actual acceptance and use is a matter which only time will reveal. In the meantime, there is little justification in referring to the possibilities disparagingly or of intimating that its use is a makeshift.

•

Mass Marketing for Cooling

WE recently learned the details which attend the launching of the first national, quantity-production-and-distribution plan for marketing residence cooling apparatus. As this marks the initial attempt to enter this predicted market by these methods, the first year results will be extremely interesting. Thought appears to be divided into two schools—those who believe that cooling is here, and those who predict that room cooling for residences is not yet an accepted fact by householders. This move on the part of a corporation which has been merchandizing in a closely related field for several years, will at least serve as an index by which to judge of the depth of the present market.

•

A Rift in the Clouds

WHILE building permits for January continued to decline, there is a favorable feature to be noted in these data. This is that the rate of decline is decreasing. Not a point to become wildly optimistic about, and yet considered with other reports the aspect is by no means discouraging.

The demand for one-family residences is growing, according to the Department of Labor. Another organization, the National Association of Real Estate Boards, in a recent survey, states positively that the need for living quarters is being hidden by the practice of families "doubling up."

In these days it is well to remember that regardless of business conditions, population continues to grow. When employment again begins to rise and mortgage money loosens up, the amount of building will be nearly proportional to the length of time the demand is held in check.

Evaluating Fire Hazards

A READING of the most recent example of building code reveals that a very large part of the code is taken up with detailed provisions made necessary by the element of fire protection. As the safety functions of most codes are really three-fold, namely, to insure structural safety, to prevent fires, and to guarantee adequate means of egress, it is easy to see that the matter of fire protection and prevention largely crowds out the other two.

Study of the figures of fire losses shows such large totals that no one is likely to argue that due attention to fire details is not necessary, or that there is not good reason for aiming to be on the safe side. The question arises, though, "How far on the safe side are the rules of construction now in common use?"

This question is of especial interest when one recalls that while the fire rules probably do help to keep down the fire menace, they certainly add considerably to the cost of building. As fast as any can be shown to be useless or overdrawn they should be revised in the interest of economy. If the possible economies from such sources were fully realized on, it is quite possible that it would not be necessary to skimp and save on the cost of mechanical equipment, including that for heating and ventilating.

Where do these rules come from, and how were they arrived at?

They come from either experiment or practice. Formerly they were almost wholly based on practice. The use of the idea of testing for fire resistance properties and of setting up a rating scale is comparatively recent. Where the results of such tests are available, there is a tendency to adapt them for use in rules, but where no such results are at hand the empirical rules still stand. Progress has had to be slow not only because of the importance of the subject, but because test methods have had to be devised. As a consequence, the status is not yet satisfactory, and altogether too many of the rules are still practice rules. Patience is required and progress is being made. As all of us have an interest in the determination of the facts, we should encourage all moves looking toward expediting the work. The longer it is delayed the longer fire rules will continue to lag behind practice and the longer some of them will continue to be ridiculously severe.

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A Century of Progress

PLANS for the great Century of Progress exposition, to be held in Chicago next year, have moved along steadily in spite of the depression. Buildings are being erected on the 400-acre site, and it is confidently predicted that June 1, 1933, the opening date, will find the fair entirely complete.

While many groups have long since perfected plans for taking part in the fair, there were no indications that the heating industry would be represented comprehensively and in a body, until recently. Now plans are afoot actively encouraged by a small group from the manufacturers' division of the National District Heating Association to bring about an exhibit.

During the past hundred years heating has advanced enough so that its story, properly told, would make an exhibit which should attract interest and attention exceeded by no other development during that time. It touches everyone intimately, and perhaps that very intimacy is one reason why the progress is so little known and appreciated at its true value. Unless plans quickly develop which will set up the progress of heating as a separate story, the public will catch the impression at the exposition that heating and its accompanying arts are merely insignificant details of building construction and operation. It deserves more attention than that.

The proposal recently advanced that a definite exhibit be organized is, therefore, worthy of support. Its originators have outlined a comprehensive and ambitious plan for their group. We wish it every success, and hope that other groups may also take active steps to insure that heating and its other related branches are not misrepresented at the fair through default.

o

Public Buildings or Balanced Budgets—Which?

THAT public works and building programs are a desirable means of improving conditions during periods of depression is an accepted principle of economics. At the beginning of the present depression these activities were greatly expanded. They served and are still serving to carry the building industry through what would otherwise be a much worse situation.

Now there is considerable disposition to slow up or even halt these works altogether on the plea of the necessity of balancing budgets both national and local. If stopped, this will deprive the construction industries of much of their work. Admittedly, the horns of the dilemma in which government bodies find themselves are sharp, but if the principle is sound how can it be argued that stopping public building work is justified even to secure a balanced budget?

Instead, much can be said in favor of continuing these projects. Among these are the fact that these buildings are necessary and would undoubtedly be built sometime anyway; that unit costs are now low; and that in most cases public credit is still essentially sound in spite of some distressing exceptions.

At best these programs of curtailment are questionable, and engineers and contractors have sound economics and enlightened public spirit as justification for using every influence at their command to insure continuance, and even enlargement, of these public projects.

Moisture—Its Influence on the Heat Conductivity of Building Materials

By A. A. BERESTNEFF

Heat loss coefficients have been studied and reported under laboratory conditions, usually with dry samples. Laboratory conditions, however, are not necessarily field conditions. The author points out that a high moisture content may increase—and even double—the heat losses as indicated by the coefficients now in use. He suggests that, as a result of work done abroad, further investigation of the effect of moisture is important.

IT is a strange fact that, in spite of the development of all branches of technique, we still find cases where one part of a certain branch is well investigated and developed while another remains neglected. An example of this is the absorption of moisture by building materials, and the accumulation of moisture inside these materials. It is well known that moisture greatly influences certain properties of building materials, among these being heat conductivity, which has particular interest for heating and refrigeration engineers.

Accumulation of moisture inside walls, roofs, and similar building parts, not only assists the absorption of moisture but also causes other troubles. Thus, accumulated water or water vapor, when in direct and continuous contact with certain materials composing the walls, may ruin them chemically and may cause the appearance of fungus growths. Moreover, if a low enough temperature exists at the point of accumulation, the water changes into ice, thus ruining the materials mechanically. In addition, the accumulation of moisture, when it comes from inside the building, means an escape of moisture and a decrease of relative humidity which, in some cases, must be maintained at a high level.

While the several problems involved in moisture penetration, absorption, and accumulation appear not to have been studied in this country, European engineers have given some attention to them. German technical literature contains some references to studies made, and some of the results and methods are included in this article as they illustrate well the point of view and angle of attack used by these engineers.

The phenomenon of moisture accumulation in different parts of buildings has been known for a long time. Many writers have mentioned it in numerous articles and books. Some of the factors which cause the accumulation are known and have been well investigated, while the influence of others is but little known even among specialists. One of these little-known factors is the humidity of air, which is the subject of this article.

At the start it is desirable to distinguish between two different processes of moisture penetration: first, penetration into a substance and, second, penetration through a substance. The first process results in the absorption of moisture by substances. The second one assists the absorption and, under certain circumstances, may result in accumulation of moisture. While both processes are of the same nature, it is convenient to consider them separately.

Further, there are two distinct cases of absorption of moisture by building materials:

1. When the material is exposed to water vapor, and
2. When the material is covered by a liquid film or submerged in water.

Materials behave differently in each case. To know all about moisture absorption it is necessary to learn the absorbing capacity of a material in both cases, because both cases can exist in practice. In doing so we will come to some interesting and often neglected conclusions. As an example, suppose we take two building materials much used as heat insulators. Table 1 shows how greatly their absorbing properties differ when they are exposed to air containing various percentages of water vapor.[1] The moisture absorbed is given in percent.

TABLE 1

Material	Relative humidity of air 0%	25%	50%	75%	100%
A	0	2.4	3.1	8.2	20
B	0	0.1	0.1	0.1	0.1

From the table we see that, when in contact with vapor, material A absorbs considerable amounts of moisture and that, when compared with material B, its non-absorbent character is far from excellent. On the other hand, the absorption of material B is surprisingly small and constant throughout the whole range.

[1] Table 1 is from "Heat Insulators," by Griffiths, Report No. 35 of the Food Investigation Board, Great Britain.

Fig. 1 shows graphically the values of moisture content in material A at different relative humidities of air. At 60% to 70% relative humidity the moisture content is about 7%, while at 85% to 90% relative humidity it is around 15%.

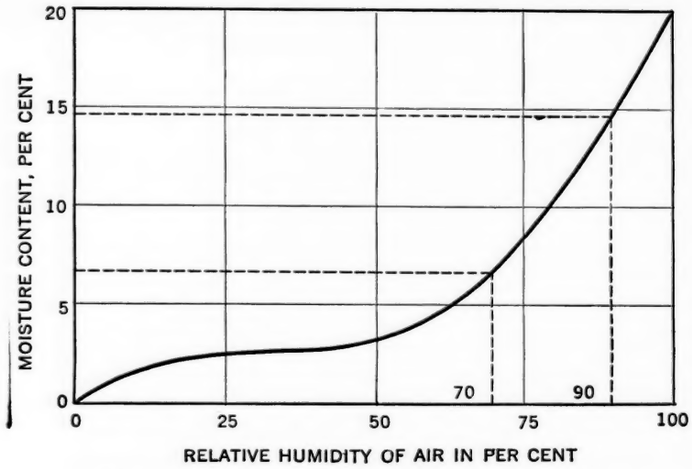


Fig. 1. Values of moisture content in material A at different relative humidities of air.

In spite of the very small absorbing capacity of material B, walls insulated with it occasionally have shown areas where the interspaces are filled with ice. The same phenomenon has been observed in other granular and fibrous materials used as heat insulators. Before attempting to explain this little known phenomenon, let us note what the above-mentioned amount of moisture content means and how much the conductivity of materials is influenced by moisture content.

We know that moisture added to an insulating building material increases its coefficient of heat conductivity. The explanation is that the moisture is a relatively good conductor of heat as compared with the substance itself.

Fig. 3 is from studies made by I. S. Cammerer[2] and shows the relation between conductivity and moisture content. Doctor Cammerer is of the opinion that this diagram represents the relation between the moisture content and the heat conductivity for all porous materials. We wonder, however, whether the same amount of moisture added can produce the same effect on the conductivity of all porous materials. We would rather expect in the case of adding say 10% of moisture both to a substance with a coefficient of conductivity of 0.3 and to a substance with a coefficient of conductivity of 0.6 (if both are dry), that the added moisture will change the conductivity of the first material to a greater extent than that of the second one. This means that the better non-conductor of heat the material is, the more dangerous is the influence of the moisture added.

From this diagram we see that even a small amount of moisture changes the conductivity considerably. In the case of material A, previously mentioned, Fig. 1 shows that, when in contact with air of 85% to 90% relative humidity, it will have a moisture content of 15%. This would mean that the increase in the coefficient of conductivity would be about 135% over its value when the material is dry. Thus, if the conductivity dry is 1.0, the coefficient for 15% moisture would be 2.35. Doctor Cammerer mentions cases where the moisture content in building materials has reached a value of 30%,[3] which means an increase in conductivity of about 200%.

The important effect of even small amounts of moisture is evident from examining the right-hand chart of Fig. 3. We can see that the increase of conductivity for each per cent of added moisture is large at the beginning. The first per cent of moisture added increases the conductivity about 30%, while the first 21% of moisture added increases the conductivity only 7% per 1% volume of moisture. Cases are known where 10%[4] of moisture was found in the insulating material A. Other data given in the same article by Doctor Cammerer show that impregnation with a waterproofing substance does not give any guarantee of full prevention of moisture absorption, since in some cases the moisture content in the treated material was found to reach 3% to 3.5%. Even such a small moisture content means an increase of conductivity of about 60%.

From the above the following conclusions can be drawn:

[2] From an article by Dr.-Ing. I. S. Cammerer, *Zeitschrift fur die Gesamte Kalte Industrie*, October, 1931.

[3] See article by Dr.-Ing. I. S. Cammerer in *Kalte*, 1930, P. 81.

[4] See article by W. Jurges in *Gesundheits-Ingenieur*, 1928, P. 304.

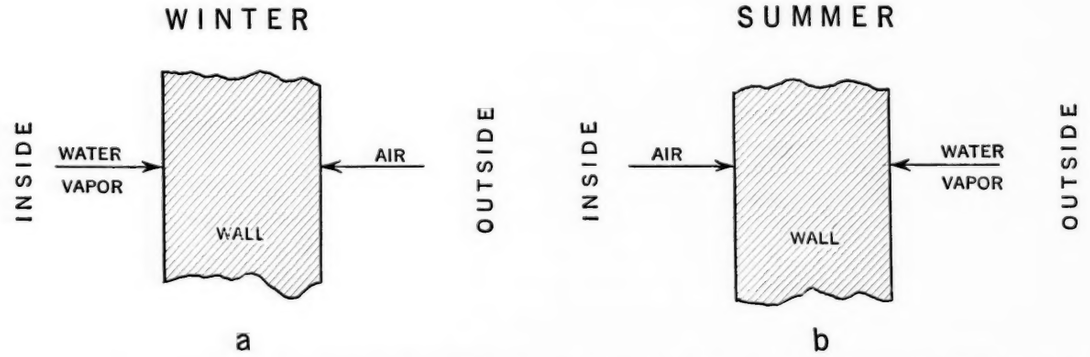


Fig. 2. In winter water vapor moves from inside towards the outside, and the air in the opposite direction. In the summer these conditions are reversed.

1. Moisture influences the heat conductivity of different materials to a very great extent, and cases are known where the moisture content reaches an extremely high value.[5]
2. Even if the moisture content is small, the change in conductivity is so considerable that all calculations of heat transmission may become wrong.
3. In cases where high humidity prevails, it is of importance that means be found to prevent moisture penetration through walls, roofs, and other parts of buildings, and for controlling the moisture content in building materials.

Let us now consider and explain some of the principles which should be taken into account in opposing the penetration and accumulation of moisture into different parts of buildings.[6] Before beginning, however, it must be made clear that the following considerations are only rough ideas pointing out the way of fighting moisture which comes from the humidity of air. The writer knows that a great deal must be done in checking and developing these ideas before exact indications for preventing the penetration and accumulation of moisture for particular cases can be given.

To begin with, the penetration of a gas through any material occurs because of the difference between the partial pressures of this gas on the two sides of the material. The amount of penetrated gas expressed in volume units is assumed to be in direct proportion to the difference between the partial pressures. To illustrate how large this difference can be, the approximate values of water vapor pressure at different air conditions are given in Table 2.

TABLE 2

Conditions	Winter (1)	Intermediate (2)	Summer (3)
Dry bulb temp., °F.	—15	30	80
Relative humidity, %.....	80	85	60
Vapor Pressure mm. Mercury	0.3	3	15

In this table conditions in column (1) are typical of outside winter conditions; in column (2) appear inside conditions as they should be maintained in some cold storage rooms; in column (3) are outside summer conditions. This table does not represent average conditions and the figures are given only to illustrate the fact that the partial pressures of water vapor inside and outside may differ considerably. In this case, for winter conditions, the difference in partial pressures is $3 - 0.3 = 2.7$ mm., and for summer conditions is $15 - 3 = 12$ mm.

Partial pressures of the air, inside and outside, depend on the total or barometric pressure. Let us assume the total pressure inside and outside to be the same. This assumption is not correct in general because we know that in many cases the total pressure inside must be higher than outside in order to provide proper air distribution, and for other reasons. Sometimes, if air is exhausted from a room, the total pressure inside is smaller than outside. We assume the total pressures to be equal only in order to illustrate our considerations by using a particular case.

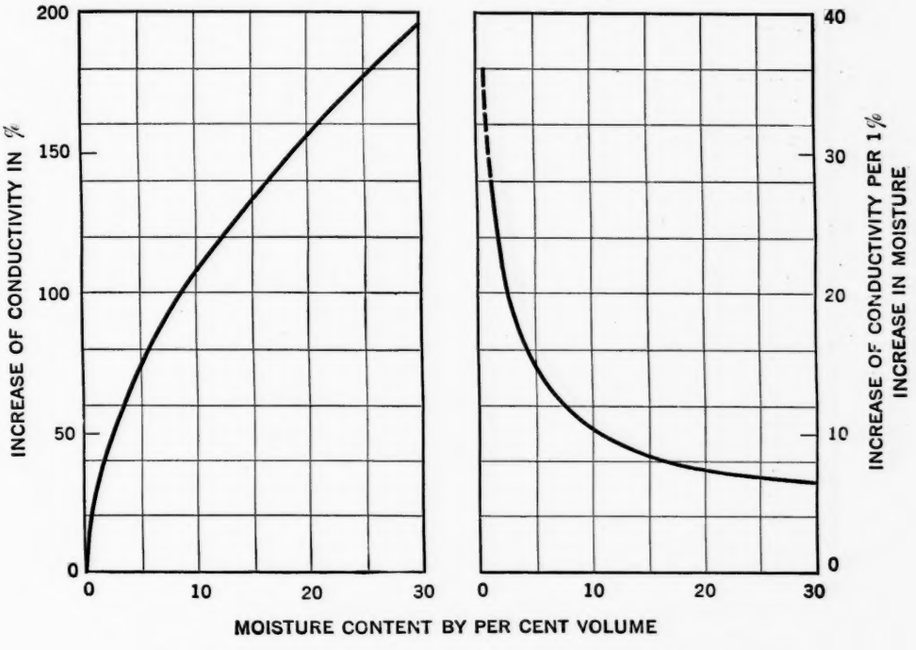


Fig. 3. The important effect of moisture on conductivity.

It is evident that at the winter conditions, water vapor will move from the inside toward the outside, while the air—its partial pressure being greater outside —will move in the opposite direction, i.e., from outside into inside (See Fig. 2a). In summer the partial pressure of water vapor outside is greater, and the partial pressure of air is smaller, than inside. Therefore, the direction of motion for both will be as indicated in Fig. 2b.

[5] Dr.-Ing. Cammerer, *Gesundheits-Ingenieur*, October, 1931, English. abstract of which appears on page 65 of this issue.

[6] Some ideas in this part are taken from an article by Professor Matschinsky, *Gesundheits-Ingenieur*, March, 1931.

Let us first consider winter conditions with temperature distribution through the wall as shown in Fig. 4. Comparing Fig. 4 with Fig. 2a it is clear that the temperature of the water vapor while moving through the wall will drop, and may reach a dew point temperature at some point inside the wall. If so, the vapor will begin to condense at this area. If the temperature is low enough the condensed water will freeze. As the greatest drop of temperature inside a compound wall occurs within the insulating material, there is a possibility that the dew point temperature will be reached inside the insulating material.

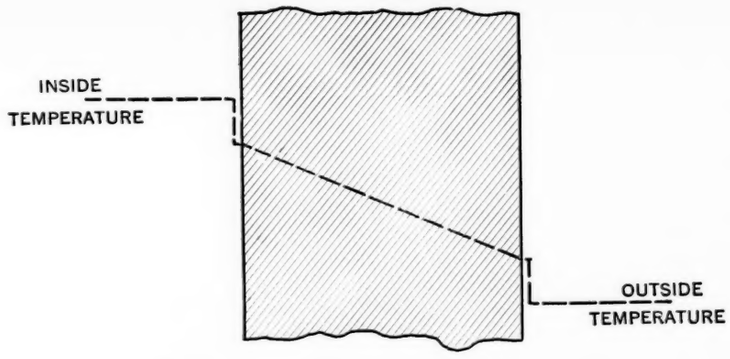


Fig. 4. During the drop in temperature through the wall the vapor may condense.

Here is a simple explanation of the phenomenon of the presence of ice inside the walls, or in the insulating material itself.

Suppose now that the accumulation of condensed water vapor occurs in the insulating material or very close to it. We then have an example of insulating material absorbing moisture in the liquid state. This would not be dangerous to some materials but would be distinctly dangerous to others, for instance, a material having capillarity.

Now let us go further and see what can be done to prevent moisture accumulation in the walls.

Suppose we have a simple wall like the one shown in Fig. 5. For such a wall the amount of penetrated gas (air or water vapor) is relatively small. Let us compute it using the following formula:

$$L = \frac{r}{e}$$

where L is the volume of penetrated gas in liters, r is the coefficient of penetration in liters per hour per square meter per millimeter of water per meter thickness, and e is the thickness of material in meters. C. Lang gives (for brick) a value of r = 3. Then for our case (See Fig. 5. The thickness of the wall in this figure is equal to 15 in. or 0.38 meter)

$$L = \frac{3}{0.38} = 8 \text{ liters} = 0.28 \text{ cu. ft.}$$

Taking into account the very small density of water vapor, the amount of penetrated vapor is thus seen to be quite small for such a wall.

Another important factor helps to prevent any considerable amount of moisture from accumulating inside the wall shown in Fig. 5. Air entering the wall from the outside will become warmer, and when reaching the point of condensation of water vapor it will try to re-evaporate the condensed water and to bring it back into the room. For these two reasons the danger of accumulation of any considerable amount of moisture in a simple wall is not too great.

Consider, however, a compound wall like the one shown in Fig. 6, which consists of a material (c) of relatively small thickness and high coefficient of penetration, and of a material (d) which is relatively thick with a low coefficient of penetration.

The water vapor will go through material c easily. When meeting the material d along the line AB, the penetrated water vapor will begin to accumulate at this line because of the much higher resistance to penetration of material d. When the dew point temperature at line AB is reached, the vapor will begin to condense so that more and more water vapor will be attracted from the inside toward line AB and the amount of condensed water will become larger and larger. On the other hand, there is no great chance for moisture to be carried away by the incoming air because the material d will resist the penetration of the air from the outside just as it resists the penetration of vapor from the inside. Thus, in a case of a compound wall, the moisture accumulation can be considerable.

Based on these considerations, the way to prevent, or at least to oppose, the accumulation of moisture in the wall built up of the two materials c and d is simple enough. It is only necessary to change the location to that shown in Fig. 7. In this case a considerably smaller amount of accumulated moisture should be expected because: (1) material d will permit the penetration of only a small amount of water vapor because of its thickness and low coefficient of penetration, and (2) the air from outside will be given a much better chance to reach the line AB. Upon reaching this line the entering air, becoming warmer, will tend to evaporate the moisture, if any, accumulated along line AB, and may escape again to the outside due to local circulations as shown in Fig. 7.

For such a case, and considering winter conditions, the conclusion is that where moisture accumulation within the wall is caused by humidity of air, the materials composing the wall should be located in such a way that their coefficient of penetration decreases from the inside toward the outside of the wall.

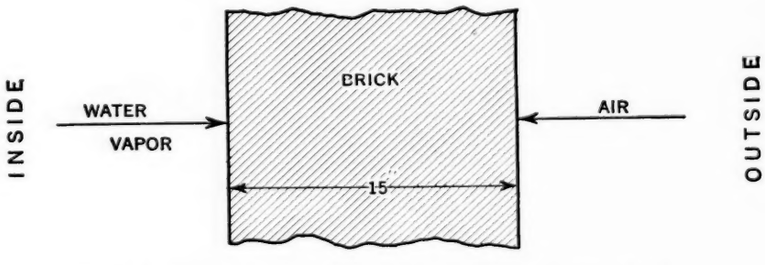


Fig. 5. A simple wall for which calculations are given.

Without analyz-

ing a similar case for summer conditions, it is clear that an opposite arrangement of materials will be desirable. This reversal does not mean, however, that nothing can be done. In some cases only winter or else summer conditions need be dealt with. In other cases one condition or the other prevails to such an extent that it is only necessary to take care of the worse.

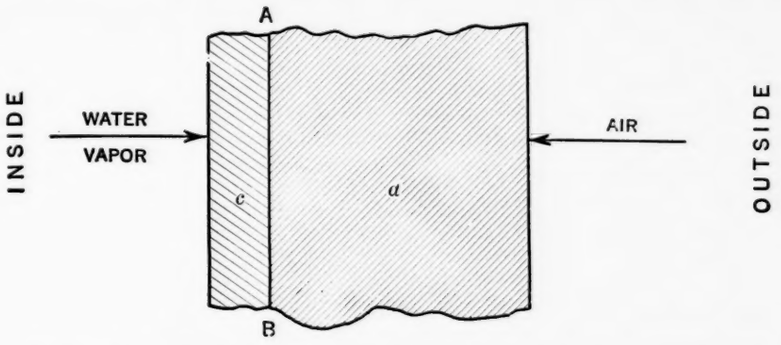


Fig. 6. A compound wall, (c) having a high coefficient of penetration and (d) having a high coefficient of penetration.

Even where winter and summer conditions are equally important, and it is necessary to take care of both, some steps can be undertaken to diminish the undesirable effect of moisture accumulation. According to Matschinsky, the following ways can be recommended for such a case:

1. Moisture-proof material on both sides of walls, roofs, etc. In this case the inside materials should be very dry and there must be an opening at the top of the wall for free circulation of air. This method is rather expensive.
2. The moisture-proof material can be located in the middle of the wall. This diminishes the temperature difference for both parts of the wall and, consequently, the danger of moisture penetration. A continuous moisture accumulation will be prevented by the fact that the moisture accumulated on one side of moisture-proof material will be given a chance to be carried away.
3. No use of moisture-proof material at all, but providing conditions of possible free circulation of air through the wall. This circulation will take care of evaporating the accumulated moisture.

These suggestions should be carefully checked. Perhaps better remedies can be found for this case as well as for other cases, and all will require a great deal of investigational work.

The preceding analysis was made with certain assumptions which are not always justified in actual cases. For example, a sufficient overpressure inside the room can change the direction of air motion and a new analysis of the whole process would be necessary. Besides that, when solving the problem of how to build up the wall or roof, it is not practical to consider the location of materials from a point of view of their coefficient of penetration only. Other important considerations of a purely structural nature also must be taken into account. Under certain circumstances they may be contrary to the considerations given in this article. It is not easy to solve this problem, but if properly handled and analyzed it can be so solved as to take care of all requirements and to reconcile all opposing factors.

Probably even with sufficient investigation it will be found that there is no general solution to the problem of preventing moisture accumulation. Each particular case seems to be individual, all conditions must be carefully studied and all processes properly analyzed. The most important factors to study are:

1. Inside and outside conditions, especially the prevailing temperatures and humidities.
2. The coefficients of penetration of gas through all materials, which comprise the walls, roofs, and other parts of buildings.
3. Temperature distribution inside the walls, etc., in order to know, at least approximately, where a dew point for prevailing conditions can be reached.

To the conclusions already made, the following may be added.

On account of the fact that moisture so greatly influences heat conductivity, this factor should be taken care of always. For example, to state that a value of the conductivity for some material is equal to 0.3 is not enough; it also must be made clear at what moisture content this value is found. In most tables for the coefficients of conductivity of building materials there is no indication as to the moisture content. Often, when the coefficients are given for insulating materials, the best value is stated. As we know, this means making the sample as dry as possible. But we also know that in many practical cases dry conditions can not be maintained and that, therefore, the values given should not be used unless a correction for the expected moisture content is introduced.

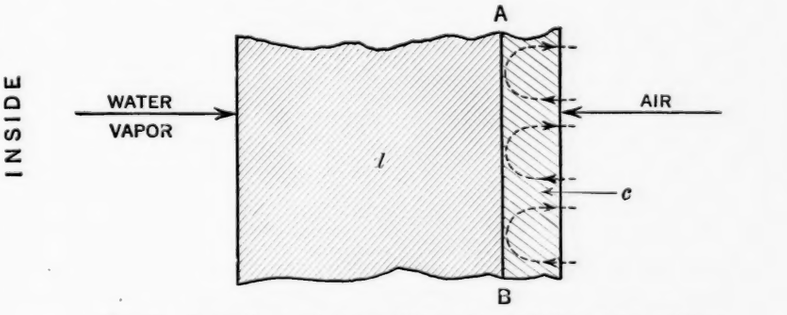


Fig. 7. A method of preventing accumulation of moisture in the wall.

In most cases of heat loss calculation, no such corrections are made, although some writers have advocated making them. The designer usually has to be satisfied with the results he gets when using the values of heat conductivity as they

are given in tables. These are the values found under laboratory conditions. That these values can be quite different from the actual values met in practice is proved partially by the fact that the actual heat losses often differ considerably from the computed values.

We hope that this discussion helps to make clear that there are two problems about which data should be secured:

1. Final establishing of the relation between the moisture content and the heat conductivity of building materials, and
2. Finding out ways for controlling, or at least determining (if possible, even predetermining), the moisture content, as well as preventing the accumulation and penetration of moisture inside walls.

So long as these problems are unsolved, correct results of heat loss calculation in any actual case cannot be expected. Lacking a solution of these problems, the whole work done on the determination of laboratory values of coefficients of heat conductivity has no considerable practical value. One cannot help wondering why all the exactness of determining coefficients with results reported to third and fourth decimal places if one per cent of moisture added can change the conductivity and, consequently, the amount of heat conducted 20% and more.

Summing up, we are led to the conclusion that:

All tables for coefficients of conductivity should also indicate the moisture content at which values given in the tables are found. A designing engineer using this table and knowing the moisture content to be expected in his particular case could make a correction in the value of conductivity using a diagram like the one shown in Fig. 3.

A long study will be required before the questions discussed in this article can be answered in full, but a clear understanding of the nature of the problems helps to prepare for the cooperative work which will be necessary to secure solutions.

Warmer Winters Not Due to Climatic Change

PROGRESSIVELY milder winters during the period from 1926 to the present time have raised much conjecture and controversy as to whether or not a protracted trend toward a warmer climate is to be expected. In a letter to the New York Steam Corporation, dated February 8, and published in the company's annual report, James H. Scarr, meteorologist in charge of the New York Weather Bureau, indicates that more cold winters are in store. His letter was in answer to five questions asked him by the steam corporation. The questions, with Mr. Scarr's answers, follow:

1. *Are the seasons changing in New York City?*

Climatically, there is no appreciable change in the seasons. That one season varies in its specific and aggregate weather conditions from the same season in every other year, is beyond doubt. As a matter of record, speaking of years as a whole, 1926 was the last "cold" year in this area. Each succeeding year was warmer than its predecessor, culminating with the warmest year on record in 1931. While each warm year or season brings us one year nearer to a reversal, still that reversal is not predictable, though none the less sure.

2. *May there not be a slight increase in average temperatures due to the radiation of heat from the increased number of buildings?*

In limited, protected areas, the heat radiated from large buildings may be appreciable. But the amount of heat so radiated is wholly negligible as a climatic feature.

3. *Has any change in the Gulf Stream affected the temperature, or is it likely to in the near future?*

There is no appreciable change in the temperature, position, volume, or course of the Gulf Stream. Its relatively warm surface waters may be spread out west or east of its normal western boundary by the persistence of easterly or westerly winds, and the warming influence of its waters imparted to the easterly winds blowing over it may at times reach the eastern coast of the United States. But such easterly winds in these latitudes are abnormal, and seldom persist long enough to affect coast temperatures, and certainly do not and never will become prevailing and, hence, have only a general effect, absorbed in the climatic range. This effect, whatever it is, will not change.

4. *Has the prevailing direction of wind an effect on the temperature?*

Yes, certainly, the prevailing direction of the wind not only affects temperature, but all climatic features of a given locality. Prevailing winds here, which are strongly from west to north, give to us a continental rather than an insular climate. Prevailing winds are controlled by the unequal heating of the earth from the equatorial to the polar areas, and the rotation of the earth. Neither of these is subject to material or progressive change.

5. *With four or five years of abnormally warm winters, are we more likely than not to have a series of cold winters?*

This is partly answered in No. 1. Five years is a long period for conditions to show a consistent departure in one direction from normal. But it is not without precedent in the record of sixty-one years, in either direction. In fact, there is one period of six years above normal. One might almost suppose from this that five and six-year cycles of warm and cold were the rule. But such conclusion is far from correct. They are more apt to be scattered in periods of one to three years, with these long periods spaced irregularly in the column.

With a Camera on a Panel Heating Installation

CONSTRUCTION PHOTOGRAPHS FROM AN ENGINEER'S ALBUM

Showing the First Radiant Heated Residence in this Country

AN engineer, an architect, and an interior decorator, meeting to discuss the design of a proposed fine residence, might lay down requirements for the heating system somewhat as follows:

The system must be easily controlled so that it can closely follow outside temperature fluctuations. High air temperatures, which would dry out the furniture, must be avoided. Space in the living quarters being quite valuable, as little as possible is to be used. The decorator, particularly, might insist that there be no radiators, either visible or enclosed, in the main living rooms.

Such an installation has been completed, and is in operation, in the new residence of Mrs. William Goadby Loew, the daughter of the late George F. Baker, at 56 East Ninety-third Street, New York. Panel heating is provided to carry about 40% of the total load, the remainder being steam heated with direct radiators. While this is the first residence to be so heated in this country, it is the second panel-heated building, the other being the British Embassy[1], in Washington, completed nearly two years ago.

Panel heating has been treated at considerable length in this publication[2]. Briefly, as used in this country, it consists of coils of pipe embedded in the ceiling, hot water being circulated through the coils and heating the ceiling to a temperature higher than that of the occupants, so that they are heated by the radiant rays from the ceiling. Under these circumstances the air in the room, being transparent to radiant heat, may be kept at a temperature below that commonly maintained.

The Loew residence is a four-story building about 80 ft. x 100 ft. in plan. The vestibule, entrance hall, reception room, powder room, smoking room, kitchen, pantry, great hall, library, drawing room, dining room and sitting room are radiant-heated. The total heating load is approximately 2730 sq. ft. of equivalent direct steam radiation, of which 1900 sq. ft. are in direct steam radiators.

The pipe coils were constructed of ¾ in. extra heavy steel pipe. The pipe was bent and welded in the form of coils to specification at a pipe bending plant. The coils were then subjected to 500 lb. of air pressure under water before being shipped to the job. The clamps, to which the coils are attached, and which run at right angles to the pipe, are clearly shown in Fig. 3.

In practically every case where panel heating is used in this building the coils are in hung ceiling construction. Exceptions to this are in the entrance vestibule, where the coils are also placed in the side walls, and in the drawing room and sitting room, where the coils are placed in cement floors under the windows. The coils are plane, one exception being a curved coil (Fig. 2) in a location where the ceiling is arched.

Figs. 1, 3, 4 and 5 are several views of the coils after being hung and before any other work on the ceiling was started. Fig. 7 shows how the coils clear the beams.

After the coils were hung, the risers were joined to the coils, as shown in Figs. 8, 9 and 10. The joints were oxy-acetylene welded, and the elbows are easy curves, as may be seen in Fig. 8. Fig. 11 illustrates the method of connecting the return lines from two coils, the two being joined into one line before dropping back to the boiler. Each coil is separately controlled on the return. In the case illustrated, the valves are hand-operated, but on the first floor electrically-operated valves controlled by push buttons are employed.

In both cases, the valves are enclosed in access panels—the only visible part of the heating system in the rooms.

Inasmuch as the coils are permanently concealed in the ceiling, it is necessary that every precaution he taken to make the job leakproof. After the coils were in place, and the welding completed, the coils, and the

[1] A description of the heating of this building appeared in HEATING AND VENTILATING, May and June, 1930.

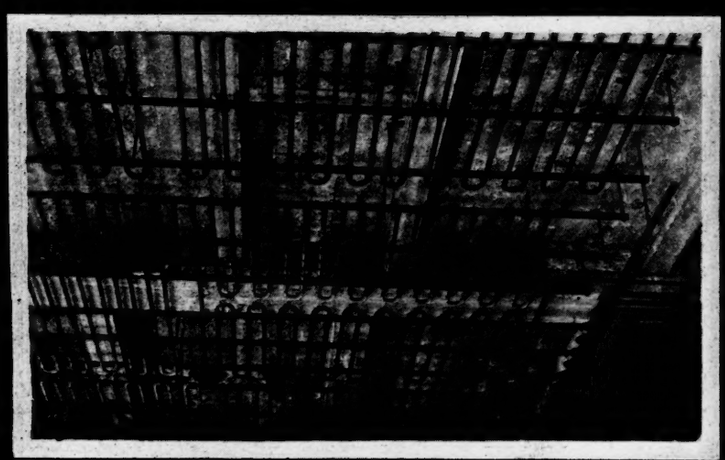
[2] The reader is particularly referred to the following articles in HEATING AND VENTILATING: "The Theory of Radiant Heating," May, 1931, page 56; "Some Temperature Studies in Radiant Heated Rooms," June, 1931, page 69; "Present Methods of Heating by Thermal Radiations," July, 1941; "Applications of Radiant Heating," August, 1931; "Calculations for Radiant Heating," October, 1931, page 62; "Results of Tests on Radiant Heating Installations," November, 1931, page 58; "The Principles of Calculation of Low Temperature Radiant Heating," February, 1932, page 48, and March, 1932, page 48.

1-COILS IN PLACE

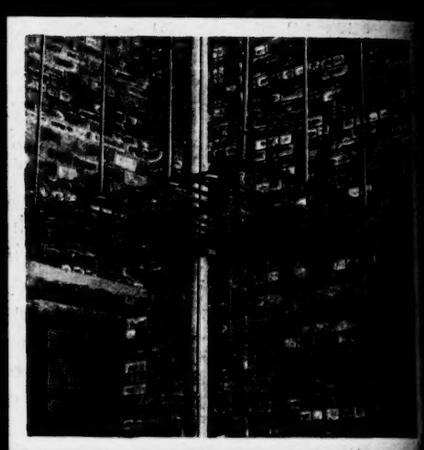
2-CURVED COIL OVER WINDOW

3-HOW COILS ARE CLAMPED TO FRAME

4-AS SEEN FROM FLOOR



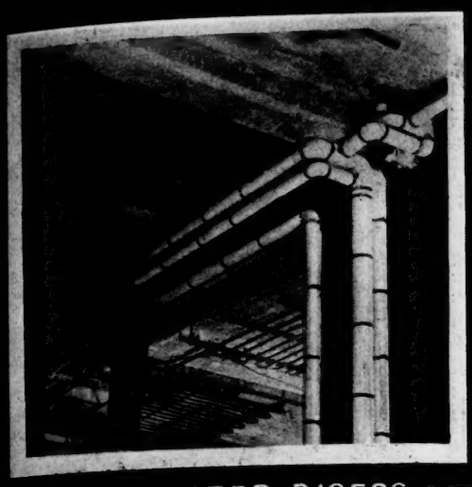
5-COILS COVER ENTIRE CEILING



6-SPECIAL COIL FOR FALSE CEILING

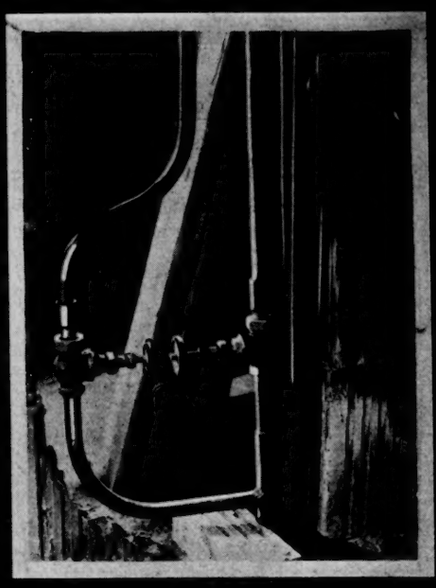
7-HOW COILS CLEAR BEAMS

8-RISER CONNECTIONS

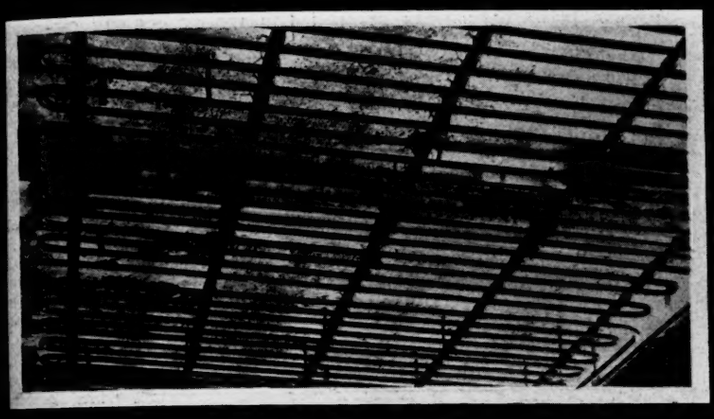


9-INSULATED RISERS

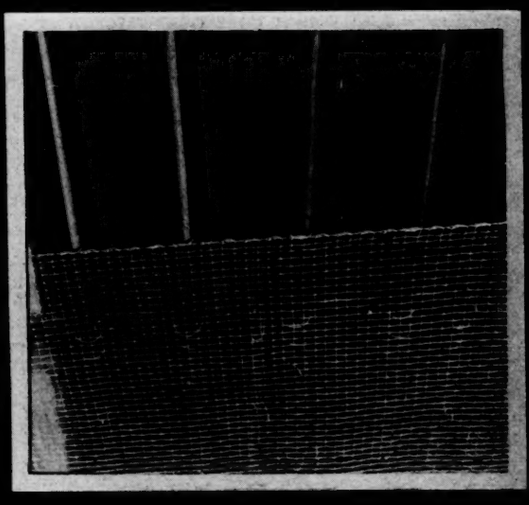
10-EASY CURVES IN BRANCHES



11-VALVES ON RETURNS

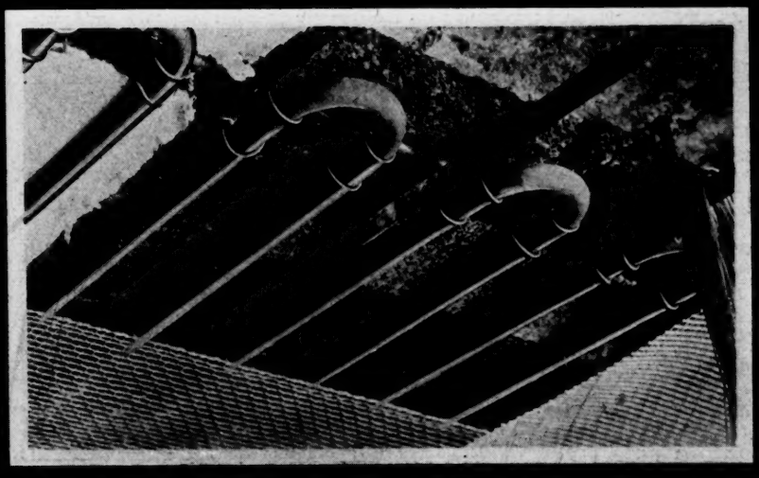


12-COILS READY FOR LATH



13-[illegible] COILS

14-WIRE LATH ATTACHED TO COILS



15-ROUGH PLASTERING

16-ANOTHER VIEW BEFORE PLASTERING

connecting piping, were again tested, this time under 300 lb. hydraulic pressure.

The idea of panel heating is to have the radiant heat rays emanate from the ceiling. Consequently, the coils must be insulated from the floor above, otherwise the heat would be conducted to the floor overhead. Figs. 13, 14 and 16 show the method of insulating as employed in the Loew residence. Two-inch thick blocks of cork are laid on top of the coils, the blocks being supported by the coils themselves.

In the case of one coil in this building, where the ceiling was not hung, the coils were laid in the bottom of the wood form for the concrete, and the concrete poured around the coils. When the forms were removed, the coils barely showed through, and the plaster was applied directly to the lath.

Fig. 14 shows clearly the appearance of the ceiling after the wire lath was applied. The lath was wired directly to the coils, and the job was then ready for the application of the plaster.

The rough coat of plaster was applied in the usual way, after which it appeared as shown in Fig. 15. A common question regarding this form of heating is how the ceiling plaster is kept from cracking. This is taken care of by the use of scrim, a coarse jute fabric, which is worked into the setting coat of plaster. The scrim becomes embedded in the plaster to such an extent that it is not visible in the finished job, except that it does impart a slightly textured surface. Also, the plaster used is one with a high lime content, which also reduces the danger of cracking.

In this connection, it might be pointed out that the maximum water temperature in the coils under design, or extreme, conditions, is 135°, and that the ceiling plaster temperature is considerably less than this.

Since the coils are concealed, the air cannot be vented at each coil. Consequently, all the high points in the system are vented to a vented expansion tank located on the top floor. The tank is equipped with an automatic water feeder to keep the system full. The system is of the downfeed type.

In any but the most simple and compact system, it is not advisable to employ gravity feed, due to the large amount of friction in the coils. In this building, the returns are connected to the inlets of two circulating pumps, each driven by a 1 hp. motor, and with a combined capacity of 100 g.p.m., against a 20 ft. head.

The water supplying the coils, and the steam for the direct radiators, are heated in one boiler, an oil-fired unit of the triple service type. The boiler has a capacity of about 5000 sq. ft. of steam radiation, the water heating sections being capable of heating 25,000 lb. of water from 115° to 135°. The boiler has sufficient space above the highest row of fire tubes to accommodate a row of brass tubular water heating elements. These elements are connected in parallel, so arranged and valved that any of them can be cut out of the service when less capacity is required, or if a replacement is necessary. A by-pass around the water heating elements, and an automatically-operated mixing valve, control the temperature of the water supplied to the coils. The control depends on a device which has one bulb outdoors, sheltered from the sun, and the other bulb in the hot water supply main beyond the mixing valve. The mixing valve is a 3-way unit, with a reversing motor capable of stopping and holding the valve in any intermediate position.

The system is designed to maintain the water temperature at 130° in zero weather, and about 80° in 60° weather, and at intermediate points depending on outside weather conditions.

The steam heated portions of the building have a conventional two-pipe vented return, with the vent trap and boiler return trap located above the boiler water line. The boiler room is depressed sufficiently to allow all piping systems to pitch back to the boiler.

Architects—
Walker & Gillette.
Heating Engineers—
Jaros & Baum.
Heating Contractors—
Wolff & Munier, Inc.

Residence of Mrs. William Goadby Loew, 56 East 93rd St., New York.

Hand-Fired Grates and Their Care

Design of Grates—Supporting Framework—Connected Mechanism—Operation—Precautions to Insure Long Life

By G. W. NIGH†

DESPITE the advances in the science of combustion of solid fuels, both on fuel beds and in suspension, a very great majority of heating and small power boilers are still fired by hand. Fuel beds are still supported on a gridwork of cast iron grates. Improvement in the design of grates is being made every year, but, nevertheless, the material is still cast iron with its well known limitations as to strength at high temperatures. It is possible to make grates of high temperature alloy steel, but the cost is still prohibitive. In this discussion, only strictly hand-fired grates will be considered, as it is not possible in one article to include stokers which are now made from the so-called hand stokers up the scale to the elaborate automatically-controlled installations.

Stationary Grates

Grates may be divided into two general classes, viz: stationary and movable. The latter word applies to the shaking or dumping type of grate. A division might also be made on the basis of size of openings to suit the sizes of fuel to be burned. This latter division is more applicable, however, in a discussion of the methods of handling fuel beds. The subject of openings will be touched upon in the detailed discussion of the various types of grates.

Stationary grates are what their name implies. They are not moved when handling a fire. A set is made up of bars set side by side to cover the floor of the furnace. These bars are made in various shapes. Fig. 1 shows one bar of what is commonly known as plain grates. Sometimes they are called finger grates. Fig. 2 shows the tupper grate. Instead of each bar, or finger, being self-supporting, the tupper has a row of short fingers carried at each side by a heavy rib. Fig. 3 shows a variation known as the herringbone grate. Another variety has rows of round holes instead of slots between the fingers and is called the pinhole or sawdust grate. These classifications cover practically all stationary grates. Occasionally, one will encounter variations and combinations which alter appearances only.

All these grates are placed in the furnace lengthwise of the boiler. Their ends are carried by supports crosswise of the boiler. One support is at the rear, usually formed by a ledge on the bridge wall of brick-set boilers. The front support is commonly formed by a lip on the dead plate at the fire door. Long grate sets have bars in two lengths with an intermediate support carrying the joint between front and rear halves. This support is a cast tee-bar set in the side walls, and on the better jobs the same type of bar carries the front and rear ends instead of using a dead plate lip and a ledge on the bridge wall.

Stationary grates are usually made with ½ in. open-

† Chief Engineer, Coatesville Boiler Works, Middletown, Pa.
Photo by Ewing Galloway

Fig. 1. Plain or finger grate

Fig. 2. Tupper grate

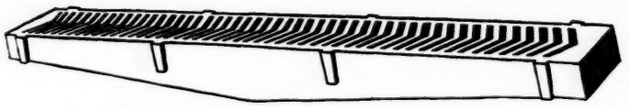


Fig. 3. One variety of herringbone grate

Fig. 4. Typical shaking grate

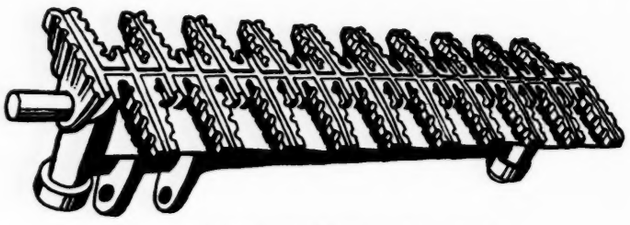


Fig. 5. An interlocking shaking grate

ings for bituminous coal. Plain grates are seldom made with smaller openings. Tupper or herringbone grates are made with smaller openings, such as ¼ in., for fine bituminous slack and the smaller sizes of anthracite down to No. 1 buckwheat. For smaller openings, the pinhole grate is usually supplied to handle the finest sizes of coal. However, there is no reason why very small openings cannot be furnished with tupper type grates, thus giving a larger percentage of air opening than is possible with the pinhole grate.

Moving Grates

Moving grates are called shaking, or rocking, and dumping. Some combinations are occasionally encountered. A typical shaking grate is shown in Fig. 4. This type, no doubt, is more used today than any other. It has a center web on each side of which are fingers spaced according to the opening called for. The upper surface, which is in contact with the fuel bed, is curved convex upward transverse to its length. This shape allows the grate to be somewhat out of level and still not have the ends of the fingers on the high side burned off. A flat top grate does not have this advantage.

Another form of shaking grate that is very popular has a smaller web near each edge and transverse fingers the width of the grate. This grate is flat on top and must be kept level. Fig. 5 shows a variation of the grate shown in Fig. 4 with every other finger shortened or omitted. This causes adjacent bars to have their fingers interlocked. A more unusual grate is that shown in Fig. 9, which has some structural and ash crushing advantages. Fig. 7 illustrates a type which, in shape, is much like that of Fig. 4, but the fingers are loose pieces held by the center rib. This gives a very large percentage of air opening. In addition, there are other shapes as every manufacturer has his own design with its own unique feature which is used to distinguish the grate.

Shaking grates are made standard with ½ in. air space between the fingers. This size will handle all but the very fine bituminous coal. For slack and non-coking coals, a smaller air space is better. The use of ¼ in. grates will greatly reduce sifting of such coals. Such grates are also suitable for all sizes of anthracite down to and including No. 1 buckwheat. For the finer sizes of anthracite, a dumping grate should be used.

Dumping grates, as the name implies, are so made that, when operated, the entire fuel bed will be dumped into the ash pit. In these grates the dumping sections are much wider than for shaking grates. There are two general designs in use. In one the entire dumping section is made in one casting, and in the other the top of the section is made in parts which are attached to the supporting bar mounted on the dumping trunnions.

Fig. 6 shows an example of a one-piece dumping grate. It is made of a framework which supports the fingers, much like the stationary herringbone grate. These fingers are curved to take care of expansion and contraction without failure. Such a grate with 3/16 in. opening will satisfactorily handle No. 2 buckwheat and can handle the fine river coal with proper care. It is suitable for natural or forced draft for all duties except very heavy service.

Fig. 8 shows one style grate made up of top sections attached to a center bar below the fire. These sections are made with slots as fine as 1/16 in. wide. The adjacent grates overlap at a bevel joint which makes an effective seal. Such a grate is suitable for the heaviest loads with forced draft.

All grates made of cast iron, in contact with coal or carbon in combustion, absorb some of the carbon into the heated cast iron. This causes the phenomenon called "growth." The grate becomes longer and wider by an amount depending upon the length of time it is exposed to the heat, and the intensity of the heat. Thus, a new set of grates will have apparently too much clearance, but after perhaps a year's service, this clearance will be very small. This action is not related to ordinary expansion due to heat which is followed by contraction upon cooling. Trouble from growth is not encountered on ½ in. mesh grates but becomes a factor with the finer opening grates.

Shaking and dumping grates are supported on a framework as illustrated in Fig. 10. This framework is made up of side rests, and a center rest if the boiler is wide. The ends of the rests are held together and apart by end grates as shown. Some manufacturers use other methods to get the same result, although the form shown is common. The top of the rests are approximately on a level with the tops of the grates, the bottom being considerably below the fire. Some makers have the rests made into solid slabs, others have them nicely trussed to have metal only where needed. In the top of the rests are grate trunnion slots into which the grate trunnions fit. These slots when plain as shown, must be deep enough to prevent the grates from jumping out of them in case a clinker is caught between adjacent grates when shaking. A number of the heavier type grates have key pieces to lock the trunnions in place, but it has been proved by practice that a satisfactory grate can be made without the added complication of the key pieces.

All shaking or dumping grates are operated by a mechanism which consists of a lever outside the setting, attached to the ash pit front. By a system of links and rods, this lever is connected to the arms on the grates themselves. Due to the great variety in design of these levers, rods, and links, none are shown on Fig. 10. However, there are certain conditions which should be met by a satisfactory mechanism. The lever outside the ash pit front should be so constructed that it can be locked when the grates are in a level position. There should be also some means provided for adjustment of the grates when the lever is in the locked position. The rod extending from the lever through the front into the ash pit must not require so large a hole as to permit air to leak into the ash pit when dampers are closed, or to permit air to leak out when the ash pit is under pressure with forced draft. Any pronounced leakage interferes with close regulation of the boiler at light loads. The ideal form of rod is a round bar passing through a neat-fitting round hole in the ash pit front.

The action of a burning fuel bed upon the supporting grates is worthy of consideration. The burning of the fuel is a chemical reaction in which the carbon and

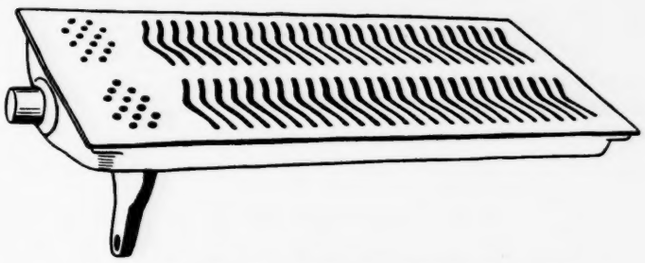


Fig. 6. One piece dumping grate

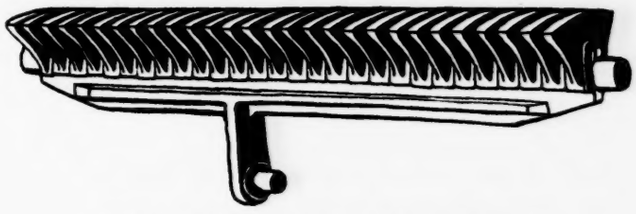


Fig. 7. Shaking grate with loose fingers

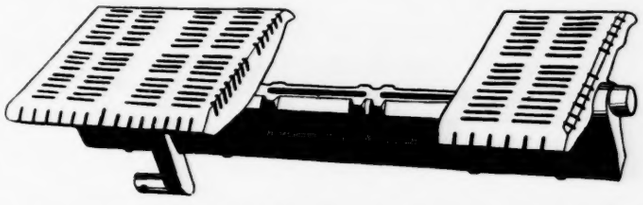


Fig. 8. Grate suitable for heavy loads with forced draft

Fig. 9. A shaking grate with ash-crushing advantages

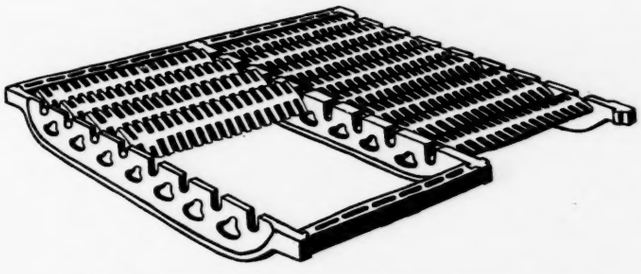


Fig. 10. Supporting framework for shaking and dumping grates

hydro-carbons in the fuel are converted to carbon dioxide and steam. To maintain combustion, a supply of oxygen, in air, is passed upwards through the grate openings and into the fuel bed. This air passing through the grates does two things. First, it supplies oxygen for combustion and, second, it keeps the grates from over-heating. The former action is well known to everyone, but the latter is often overlooked. The fireman, who raises the steam pressure by a very hot, thin fire on the grates, and then suddenly shuts off the air supply by entirely closing ash pit doors, provides an ideal condition for ruining his grates. When close to a hot, thin fire, grates must not have their air supply suddenly cut off or they will tend to warp and sag due to the heat. This is one of the most common causes of grates warping as a set. A gradual reduction of the air supply or the maintaining of a layer of ash between the combustion zone and the grates will overcome this trouble.

Another condition which causes overheating of grates is many times encountered where a forced draft is used. If the forced draft pushes more air through the grates than the stack and breeching can take care of, a slight positive pressure will be developed in the firebox or furnace over the grates. This drives the hot gases out through every possible opening, such as cracks at the firedoor, and causes the heat to penetrate through the fuel bed to the grates. Continual operation with a pressure in the firebox will not only ruin the firedoor and liners, but will warp the grates and cause the grate rests to sag. This sag is due to the upper part of the rests becoming so hot that the metal cannot withstand the stress necessary to carry the fuel bed load.

Negligence on the part of the fireman, in allowing the ash pit to fill up with ashes and then shutting off the air supply to the grates, is the most common cause of grate failure. If this condition occurs when there is a hot fire, complete failure of the grates will result. Neglect of this has made necessary the commonly seen lettering on ash pit doors "Keep ash pit clean" and "Clean out ashes daily."

An unusual condition which occasionally arises is the case where a thin hot fire is made with a coal having an ash with a low fusing temperature. The ash melts and runs down on the grates, stopping up the air passages. The remedy in this case, if the same coal is in use, is to carry a heavier fire with a layer of dead ash on top of the grates to protect them.

Stationary grates should be used only where the firedoor is on a level with the tops of the grates. This is true because all but the fine ashes must be taken out through the firedoor. Also, the fuel bed must be stirred or broken up with the slice bar. When the firedoor is on a level with the grates, it is not possible to carry a thick enough fuel bed to secure the long firing periods demanded of heating boilers. For these reasons, stationary grates are seldom used with the standard firebox heating boiler. They are still quite extensively used with brick-set horizontal return tubular boilers, and almost universally on Scotch marine type boilers.

Shaking grates are widely used for hand firing. They are standard equipment on all the widely used makes of firebox heating boilers and each year sees a larger percentage under H.R.T. boilers. Due to lack of room, they have made no headway in Scotch marine applications. For territories supplied with small grades of anthracite coal, dumping grates are much used in place of shaking grates.

When handling a set of grates, if the fireman will consider the action of the various elements, he will not be complaining of trouble with warped grate bars. The shaker sections themselves have so large a percentage of air space that the metal sections are adequately cooled by the air passing through. The rests and end grates are not so well taken care of in this respect. The end grates are over the supporting ledges or bars, and the air spaces fill up with ashes. The rests must have the metal necessary to carry the load. Therefore, the intelligent fireman will be careful of these parts by not leaving them bare and exposed to the hot fire. This is best accomplished by not cleaning all the ashes off the end grates and rests. Shaking the grates cleans the shakers only. Therefore, the rests and end grates will always have a protecting layer of ash, unless the operator removes this layer with a firing tool.

Shaking grates forming the lower grates on downdraft boilers must be protected by a layer of ash or live coals. The fire from the upper grates is above them and they are exposed to the direct radiant heat which may badly warp them unless they are covered at all times.

A set of dumping grates is much like a set of shaking grates, except that the fuel is usually finer, and grate clearances are smaller. With proper operation, dumping grates are not so near the incandescent zone of the fuel bed and are not so subject to warpage and growth as are shaking grates. However, during the period just following the cleaning of the fire, the grates are bare and exposed to direct heat. Any warpage and growth occur during this time, until a layer of ash is built up between the grates and the layer of burning fuel. The proper procedure is the same as for shaking grates. Let the dumping sections clean themselves, but do not attempt to clean off the rests and the ends of stationary sections. Leave them under a protective layer of ash. Dumping grates must be leveled carefully and locked before renewing the fire over the section dumped, or the grates will soon be in such shape that they cannot be leveled.

The fireman must operate his grates keeping in mind that the grates stand up and carry the fire only by being cooled by the air passing through. This one statement covers the entire situation. Shutting off the air supply when the fire is hot will let the grates overheat. Certain parts of the grate sets cannot be air cooled as well as the grates themselves and, hence, should be left with a protecting layer of ashes. Always keep the ash pit clean. Always maintain a draft over the grates. The lower grates of downdraft boilers, having no air passing through them, must have protection with a layer of ash or coals. The intelligent fireman who observes the above rules will not be ordering grate repairs frequently. Conversely, one who does not take proper care of his grates will ruin them, even though they are the finest and highest-priced set made.

Filtered Air for Hay Fever and Asthma Treatment

By FRANK C. TAYLOR†

IT is quite generally believed that some cases of hay fever and asthma are caused by the super-sensitiveness of the individual to certain air-borne substances in the air he breathes or to substances in the food which he eats. As a result, many doctors prescribe a diet from which are eliminated substances which have been found by test to affect the patient harmfully. Considerable work has been done in determining the effect upon the patient of filtering the air which he breathes, and by such filtration eliminating pollen, house dust, fungi and other air-borne particles to which he is highly sensitive and which may be the cause of hay fever and asthma.

It has been definitely shown that some hay fever or asthma patients may find complete relief by going to certain parts of Canada or the Adirondacks where the particular substance which causes their hay fever or asthma is not present in the air. The relief obtained in Canada or the Adirondacks is due to the fact that rag weed, pollen dust or whatever substance causes the patient's hay fever or asthma is not present in certain sections of the country.

In 1924, Professor Van Leeuwen, University of Leyden, Holland, published a paper in which he gave the results of experiments on filtered air in cases of asthma. He found that many cases of asthma in Holland were due to the fact that there was an air-borne substance in the air which caused the attacks of asthma. His further experiments indicated that patients suffering from asthma in a certain house could be freed from the attacks if they stayed in a room so ventilated that only clean air could enter.

In 1925, Dr. Leopold, of the University of Pennsylvania School of Medicine, made further experiments along the same line and found that if the room was kept relatively dust free the patient with dust asthma was kept free of asthmatic seizures.

In 1928, Dr. Milton B. Cohen in a paper entitled "Further Observations on the Use of Filtered Air and the Diagnosis and Treatment of Allergic Conditions," gave the results of his experiments with filtered air in cases of hay fever and its accompanying asthma. He found that if the patient's bedroom was supplied with filtered air during the hay fever season that it was possible for the patient to follow his usual occupations, eliminating over-exposure to pollen such as would be experienced if he played golf, tennis or rode in an auto through the country. Dr. Cohen found that the number of hours necessary for the patient to stay in the room in which the air was filtered varied directly with the air pollen concentration. In other words, at the height of the hay fever season the patient would collect sufficient pollen when following his normal occupations so that it would be necessary to spend more hours breathing the pure air in the room.

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Dr. Cohen found that it was possible to keep the average patient symptom free by varying the length of time in the room from a minimum of 8 hr. to a maximum of 18 hr. at the peak of the season. He further found that all patients who had been previously relieved by residence at a hay fever resort or by serum treatments were rendered free from symptoms of hay fever by living in the filtered air room for a few hours a day and usually not more than 8 hr. were required. For our purpose it is sufficient to derive the conclusion from Dr. Cohen's experiment that removal of dust, dirt, pollen, and other air-borne particles from the air was shown to be of decided benefit in cases of hay fever. Here it must be stated that the contents of the room must be carefully investigated so that there may not be certain substances in the room, such as feather pillows, dust and dirt which may be more harmful to the patient than any substances which could be brought in through the open window.

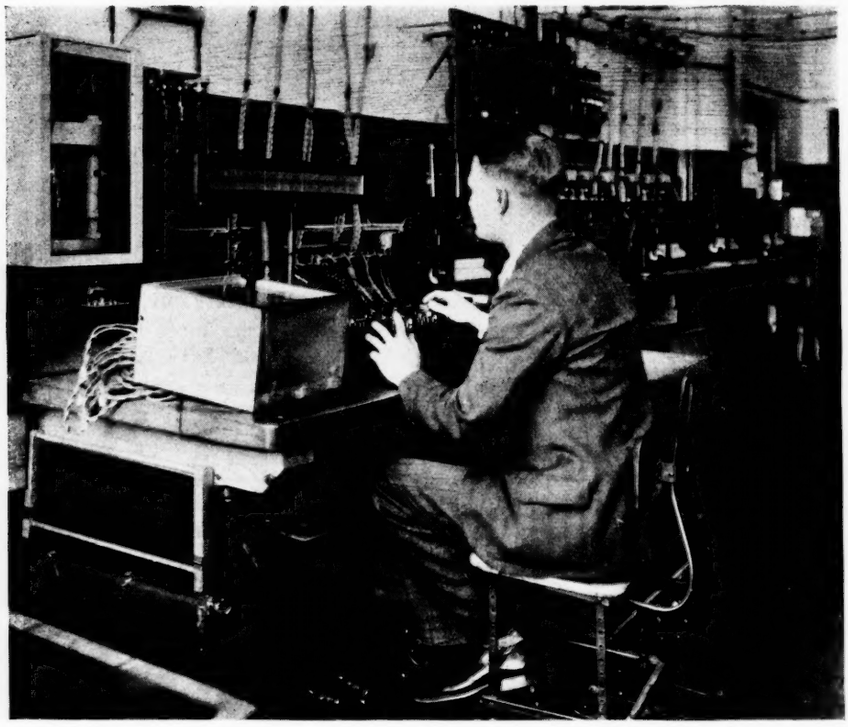
In 1930, Dr. Peshkin and Dr. Beck, Mt. Sinai Hospital, New York, made some very interesting experiments with a mechanical air filter in the treatment of hay fever and pollen asthma. They found that the time required for the patients to be in the clean air room ranged from 8 hr. to 18 hr., depending upon the individual and the amount of pollen in the outside air.

The investigations apparently indicate that the use of mechanical air filters has proved of definite value in certain cases of hay fever and asthma. However, the conclusion should not be drawn that filtered air alone will cure hay fever and asthma, but should be used in conjunction with desensitization treatments, proper diet and such methods to improve the physical condition of the patient as may be deemed advisable by the doctor in charge of the case. In the investigations mentioned, in practically every case use was made of a window filter consisting of a fan which forced the air through some filtering medium such as cotton or paper.

If supplying clean air to one room during the sleeping hours of an individual with hay fever or asthma is of definite benefit, it seems only logical that, if the air in the whole house is filtered, further benefit may be derived by those suffering from hay fever or asthma, and in addition the health of those in the home should be better. You may think that this is merely a dream and is not at all practical, but it has been a reality for some time; in fact, for over three years I have had a filter and fan attached to my warm-air furnace, continuously vacuum cleaning the air in my home during the winter months, and in summer drawing in fresh air from outdoors, filtering out the dust and dirt and supplying clean, cool air through the furnace ducts to the various rooms in the house. In the case of those suffering from hay fever or asthma, the type of filter used is extremely important, because the efficiency of the filter must be high, since otherwise the fine particles of pollen and dust would pass through into the house.

Temperature Measurement—Some Common Errors and Their Correction

By W. J. KING†



TEMPERATURE measurement is a fine art. All too often it is regarded merely as a matter of hanging up a thermometer and taking a squint at it. In some cases this may happen to give the correct reading, but in general the observer is apt to be too optimistic. The value of a very considerable number of commercial tests and laboratory researches is heavily depreciated by the poor technique so frequently used in measuring temperatures. The literature of heat transmission in particular is cluttered up with a mass of worthless data based on crude temperature measurements. The object of the present paper is to call attention to some of the more common errors, and to suggest methods for correcting them.

Many eminently "practical" engineers have a contempt for ultra-refined technique, and are impatient of attempts to measure temperatures within a tenth of a degree. They usually want results of "engineering accuracy," and want them in a hurry. But in dealing with heat and temperature it is very frequently necessary to *aim at* tenth-of-a-degree accuracy in order to get it within 10°. That is, considerable errors are apt to occur even with the best of technique, and if no care is taken the entire test may be rendered worthless. In general, if a test on thermal apparatus is worth running at all, it pays to do it carefully.

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Underlying Principles

It is well to keep in mind that there is usually a heat balance involved in measuring temperatures with a thermometer or thermocouple. That is, the heat flow to the bulb or junction is balanced by the flow away from it. The indicating device simply registers the equilibrium temperature required to maintain the balance. In general if we let

t = true temperature of the medium,
t_i = indicated or equilibrium temperature,
t_s = temperature of the surroundings,
h_1, h_2 = coefficients of heat transfer to and from the point in question, and
q = rate of heat flow

then

$$q = h_1 (t-t_i) = h_2 (t_i-t_s) \qquad (1)$$

$(t-t_i)$ is, of course, the error. If the surroundings are warmer than t, it is merely necessary to change the signs of the temperatures.

This equation suggests several ways to reduce the error. First of all if $q = 0$, that is, if there is no heat

flow, $(t-t_1)$ must be zero no matter how small h_1 is. This is illustrated in A and B, Fig. 1. A shows a thermometer inserted in a porcelain tube wound with a layer of copper wire. If the wire is heated, by the passage of an electric current, the thermometer will indicate the true temperature of the copper, even though the thermal resistance of the porcelain and air gap is high, assuming that sufficient time is allowed for equilibrium to be attained. There is no flow of heat because the temperature on all sides is the same. Similarly in B, where the thermometer is submerged in a well, in poor thermal contact with the walls, it will read the true temperature of the steam in the pipe.

If heat flow is inevitable, another recourse is to make h_1 as large as possible. For example, in measuring the temperature of air or any other gas with a thermometer, the higher the velocity of the gas over the bulb the greater will be h_1 and the smaller the error. This is the main reason for whirling a sling psychrometer in measuring wet bulb temperatures.

Another method is to decrease h_2, or the rate of heat exchange between the point of measurement and the surroundings. In using thermocouples this may be accomplished by using smaller wires, reducing the conduction to or from the junction. Many engineers who would not attempt to measure the outdoor ambient temperature without shielding the thermometer from the sun, still try to measure the cabinet air temperature in a refrigerator with the bulb exposed to a pan of ice or a heating box.

In other cases where it is not practicable to bring the entire surroundings to the temperature of the point of measurement, it may be done in effect by applying local heating or cooling near the point. This is the principle of the compensated thermocouple described by Boyer and Buss, and Roeser and Mueller. In some of the proposed designs, however, the thermocouple pads cover so much of the heated surface being measured that the heat cannot get out, and the temperature rises considerably above normal, particularly if the surface is heated electrically. To avoid this the writer has used the device shown in Fig. 2, with very satisfactory results. It is particularly adapted to laboratory use, in exploring the temperature at a number of points over a surface, or in measuring the temperature of a rotating surface. The current through the small internal heating coil is adjusted by means of a rheostat until the readings of the internal and contact thermocouples are the same. This scheme obviously cannot be used when the surface is colder than the surroundings, although conceivably a little cold brine might be circulated through an outer tube or jacket and the temperature regulated by the heating coil.

Measurement of Gas Temperatures

In measuring air or gas temperatures, the effect of radiation needs to be emphasized, because it is very frequently a source of error. Most engineers appreciate this in dealing with high temperatures, but seem to be inclined to underestimate its importance at low temperatures.

To demonstrate the influence of radiation, two 24-in. calibrated mercury thermometers were hung up in front of an office window on a moderately cold day. The two bulbs were about a half inch apart, and one inch from the glass. They both read 73.2° F. A small semi-cylindrical skirt of bright aluminum foil was then fastened around one of the bulbs to shield it from the cold window pane. It then read 2.45° higher than the other, and this same differential was observed when the skirt was transferred to the other bulb.

Errors of this sort are very apt to occur in testing air conditioning apparatus, particularly when humidity is measured in terms of wet and dry bulb temperatures. A striking example of this recently came to the writer's attention in connection with some tests on a cooling unit. Calculations based on the difference between the humidities of the incoming and outgoing air indicated that a pound and a half of moisture was condensed out of the air per hour, although the lowest temperature of the cooling coils was 27° above the dew point of the air. The refrigerating effect required to remove this much moisture was about equal to that required to remove the sensible heat from the air, as indicated by the lowering of the dry bulb temperature, and the total balanced very well with the heat absorption measured

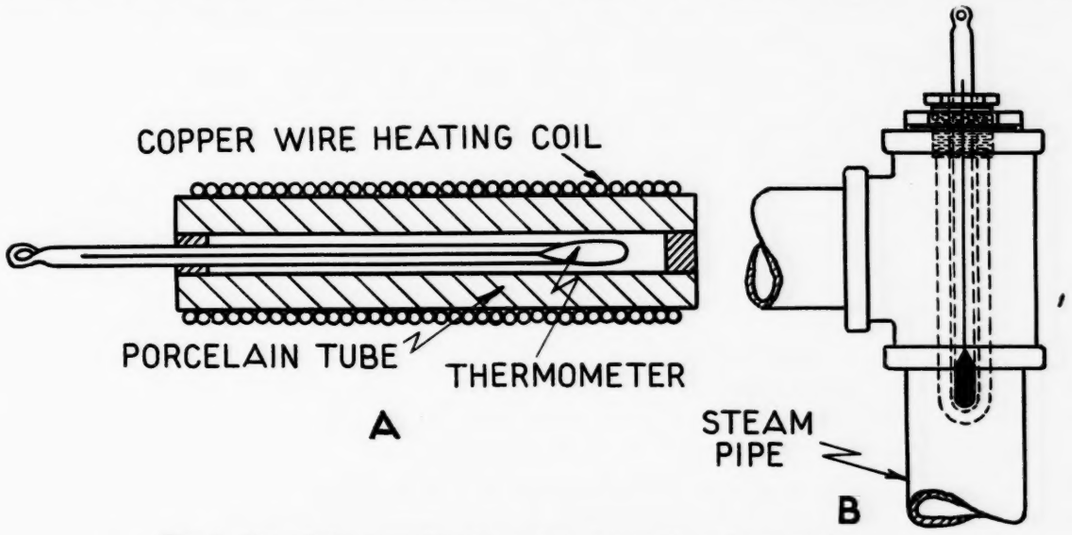

Fig. 1. Use of thermometers in regions where there is no heat flow.

by another method. The cooling coil temperatures were measured by several thermocouples, and ran only a few degrees warmer than the refrigerant inside, as indicated by a pressure gauge.

Similar results were obtained from five separate tests, run on different units over quite a period of time. The data all hung together so well, and the heat balances were so convincing that it was very difficult to imagine where the error might be. It was equally difficult to imagine why so much water was condensed out of the air, at temperatures considerably above the dew point. Several ingenious theories were evolved to explain why moisture should be condensed from a blast of air by

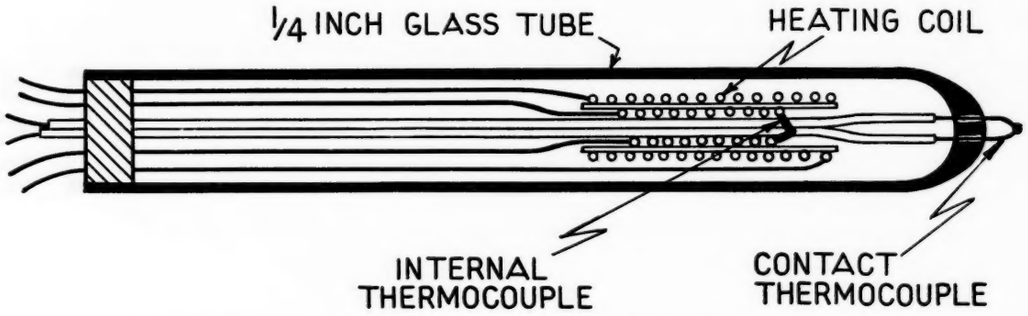

Fig. 2. Compensated thermocouple for measuring surface temperatures.

finned tubing under these conditions. Special tests were run on a single length of finned tubing by way of verification, but this time no moisture was condensed above the dew point.

Finally, it was discovered that nobody had ever *seen* any moisture on the cooling coils—it had only been *calculated* from the humidities. It was then observed that the tests were run in a 100° room, while the wet bulb temperatures of the cooled air sometimes ran as low as 65°. After correcting all air temperatures for the errors due to radiation, it was found that the moisture content of the air leaving was always the same as that entering the unit.

In this connection it should be noted that a small error in measuring the wet bulb temperature may make a considerable difference in the apparent humidity. For example, at a dry bulb of 70° an error of 2.5° in the wet bulb reading may change the apparent relative humidity from 40% to 50%. The wet bulb is particularly apt to read too high in dry air, because of its depression below the temperature of the surroundings.

This matter of accurate temperature measurement in psychrometry is of such general importance that it merits more detailed treatment here. The following discussion refers particularly to the use of ordinary thermometers, mounted in an air stream at atmospheric pressures, to measure (a) dry bulb and (b) wet bulb temperatures.

(a) Dry Bulb.

If

t = true temperature of air, °F,
t_1 = thermometer reading, °F,
t_s = temperature of surrounding walls, etc., °F,
h_c = forced convection coefficient, bulb to air, B.t.u. per hr. per sq. ft. per °F,
h_r = radiation coefficients, surroundings to bulb, B.t.u. per hr. per sq. ft. per °F, and
A = area of bulb, sq. ft. (cancels out),

then, the heat balance will be given by the equation:

$$h_r A\ (t_s - t_1) = h_c A\ (t_1 - t) \qquad (2)$$

Strictly speaking, the radiation will be a function of the fourth powers of the absolute temperatures, but for the range of temperatures ordinarily involved in psychrometry it may be represented by an equivalent coefficient, h_r, of about 1 B.t.u. per hr. per sq. ft. per °F.

h_c is a function of the air velocity, as indicated in the following table, based on Chappell and McAdams' formula, for a bulb about ¼ in. in diameter:

Vel., ft. per min.	100	200	300	400	500	600	700	800
h_c	3.3	5	6.4	7.7	8.7	9.6	10.3	11

For example, if

$t_s = 100°$,
$t = 76°$
Vel. = 200 ft. per min.

then

$t_1 = 80$, or the thermometer would read 4° too high.

On the other hand, if

$t_s = 80$
$t = 70$
Vel. = 800

then

$t = 70.83$, or the error would be only 0.83°.

The occasion for taking special precautions, therefore, depends upon these three variables.

(b) Wet Bulb.

In this case the heat balance includes the loss by evaporation from the wick, thus:

$$h_r A\ (t_s - t_1) + h_c A\ (t - t_1) = h_d A\ (p - p_a) \qquad (3)$$

where

H_d = diffusion coefficient, B.t.u. per hr. per sq. ft. per in. Hg.
p = vapor pressure of water at the temperature t_1, in. Hg.,
p_a = partial pressure of water vapor in the air, in. Hg.

The pressures may be taken from a psychrometric chart, and h_d may be obtained from the above values of h_c since $\frac{h_d}{h_c} = 0.0116$ with only a very slight variation over the entire chart.

The calculation of the error here is somewhat more awkward, as it is first necessary to assume the value of t_1 and then check it by a cut-and-try process. For example, let

$t_s = 100$
$t = 80$
Relative Humidity = 30%
(wet bulb = 60°, $p_a = 0.309$)
Vel. = 400 ($h_c = 7.7$, $h_d = 664$).

Assume $t_i = 62.5$
so that $p = 0.57$.

This will balance equation (3), the heat transfer rate being 173 B.t.u. per hr. per sq. ft. on both sides. The error is thus 2.5°, indicating a humidity of 37%, if the dry bulb, t, was correct.

The foregoing suggests that if the test conditions are such that appreciable errors are likely, any one of three methods, or a combination of them, may be used to correct the readings:

(1) Calculate the error by means of equations (2) and (3).

(2) Shield the bulbs from radiation by surrounding them with cylinders of bright metal, such as aluminum, in such a way that they get the full benefit of the existing air velocity.

(3) Increase the air velocity over the bulbs by means of a small suction tube connected to a vacuum pump or blower.

Fig. 3 shows a device, first suggested in an article by Haslam and Chappell, which has been used to measure air and gas temperatures under a variety of conditions. Three effects conducive to correct readings are obtained:

(1) The thermocouple junction is shielded from radiation by the metal tube.

(2) The heat transfer rate from the gas to the junction is increased by the high velocity stream drawn over the junction.

(3) The conduction away from the junction along the wires is practically eliminated, since the wires are swept by the same gas stream for some distance along their length.

The use of such a device in measuring hot air temperatures in a water-cooled pipe is illustrated in a recent paper by Colburn and King. At one point, under the same conditions, the high velocity thermocouple read 412°C., a plain bare thermocouple read 397°C., and an uncovered mercury thermometer registered 366°C. It was also found necessary to explore carefully the *distribution* of the temperatures over a cross-section of the tube. For example, near the exit from the water-cooled section the air temperature at the axis was 218°C., at a point 1 in. away it ran 173°C., and ¼ in. from the wall it was 108°C.

Vapor Temperatures

The measurement of the temperature of a *saturated* vapor is usually a very simple matter, and the errors are apt to be negligible. It is frequently convenient to read the temperature in terms of the pressure by means of a gauge or manometer.

However, if the vapor contains a considerable amount of air or other non-condensable, precautions become necessary. A gauge will read the total pressure, indicating a higher temperature than that corresponding to the actual partial pressure of the vapor. And unless the velocity is high, or the conduction away from the point of measurement is reduced, a thermometer or thermocouple may be surrounded by a film of the non-condensable, through which a temperature drop occurs.

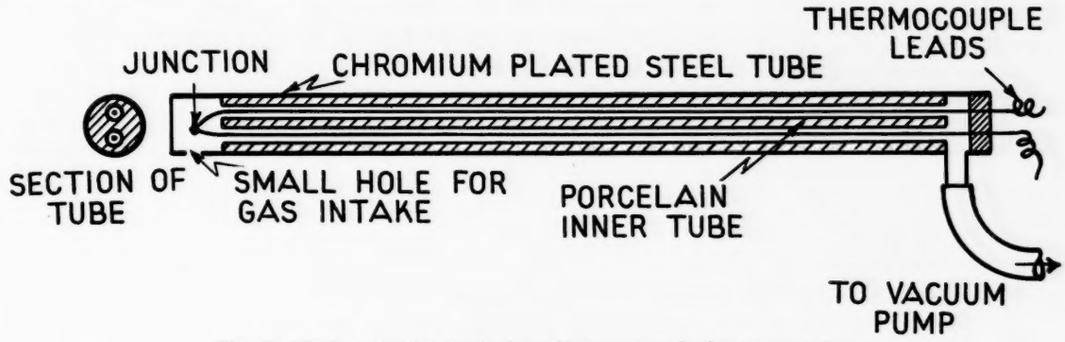

Fig. 3. High velocity aspiration thermocouple for measuring gas temperatures.

In the case of a slightly superheated vapor, a thermocouple is quite likely to read the saturation temperature, if the cooling action due to conduction is not reduced.

Measurement of Liquid Temperatures

As a rule, liquid temperatures are easy to read correctly, because radiation is eliminated and because the heat transfer rates to the thermometer are high, particularly under turbulent flow conditions. In many practical cases, when the liquid is contained in a closed vessel or a pipe, fairly close readings may be obtained by merely soldering a thermocouple to the metal wall, *provided that the area around the junction is not transferring heat.* A steam or hot water pipe in still air will run very close to the fluid temperature, if the surface is covered locally by a pad or lagging.

However, it is one thing to measure the temperature *at a point* in a liquid, and quite another to measure the average temperature in a body of liquid in which steep temperature gradients occur. It is particularly difficult to measure the average temperature of a stream of oil, because of the tendency of viscous fluids to run in hot and cold streaks. This is strikingly illustrated in a recent paper by Drew, Hogan and McAdams, in which it is shown that a number of tests on oil heat exchangers have been rendered worthless by this effect, and in the work of Higgins and Davis on transformer oils. For example, the latter gives the following figures for the temperatures at

various points in the oil across a section of a pipe: 75, 54, 84, 73, 73, 65, 69, 69, 50°C.; range, 50°C. to 84°C.; mean, 68°C. It is, therefore, absolutely essential to use a mixing cup or a similar device to mix up thoroughly the temperature streaks in dealing with a viscous fluid.

Surface Temperatures

In measuring surface temperatures, thermometers should be used only for very rough work, because of the poor thermal contact which usually exists between the bulb and the surface.

For accurate work, thermocouples are almost universally used. The greatest problem here is to reduce the conduction of heat away from the junction along the wires. This is discussed in an excellent paper by Colburn and Hougen, and also by Adams and Kean. In measuring the surface temperature of poorly conducting materials, such as pipe lagging, wood, brick, etc., it is especially important to have a considerable length of the wires from the junction in intimate contact with the surface. In dealing with metal surfaces, it is necessary at the same time to have the wires electrically insulated from the surface, since the potentiometer indicates only the temperature of the nearest junction point of the two wires.

One of the writer's associates, H. S. Young, Jr., has developed an excellent form of thermocouple for such purposes. It consists of a 15-mil constantin wire contained within a capillary copper tube having a wall thickness of 6 mils and an outer diameter of 1/16 in. The annular space between the wire and the tube is filled with an aluminum oxide powder, packed in a little at a time by means of another tube which slipped over the wire and into the outer tube. A junction is formed at the end between the constantin wire and the copper tube. In using this it is only necessary to solder a few inches of the copper tubing to a metal surface, or to fasten it securely to a non-metallic surface.

General

For a more detailed treatment of the many problems involved in the measurement of high and low temperatures, the reader is referred to the accompanying bibliography. The A.S.M.E. Power Test Code is particularly recommended. An excellent discussion of the general theory and practice is also contained in the German text by Knoblauch and Hencky.

It is hoped that the foregoing discussion will stimulate a more critical attitude toward this matter of temperature measurement, for it is evident on all sides that the careless methods so frequently employed in engineering practice are creating a great deal of unnecessary expense and confusion.

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Fig. 1. Spray pond on roof

Air Conditioning

By WILLIAM HULL STANGLE

Part XVIII—Condenser Water for Refrigeration

By REALTO E. CHERNE†

ONE of the most important problems confronting the designing engineer is that of providing adequate condenser water to serve the refrigeration machines. The question is really a two-fold one, viz:

(1) What is the best source of this water under the conditions of the particular job?
(2) When the source is decided upon, how can the water be best handled?

Too often these questions are not given proper attention initially with the result that improper or inefficient operating conditions may result.

In considering the question of condenser water and its handling, the important relation between the temperature of this water and the capacity of the refrigeration machines must be kept in mind. As the exit temperature of the condenser water rises, the capacity of a refrigeration machine falls off. Thus, a machine operating on 70° water will have more capacity than one operating on 90° water, other conditions being the same. In order to get the best capacity from the machine it is necessary to keep the temperature of the condenser water low. Often, however, adequate low temperature water, if obtainable at all, can be secured only at relatively high cost.

Sources of condenser water are (1) free surface water, such as that available from rivers, lakes or ponds; (2) sub-surface water, such as that obtainable from wells or through city supply lines. In general, water from source (2) will reach the condenser on any given day at temperatures considerably lower than that obtained from source (1).

Conditioning plants located close to rivers, lakes, and ponds ordinarily use this water for condensing purposes. The cost of water for such installations is equal to the over-all owning and operating costs of pumps and piping. This ground water is perhaps the largest source of cooling water.

When well water is available in sufficient and reliable quantities, it is advisable to use this supply for condensing purposes. The cost of condenser water in this case is again equal to the over-all owning and operating costs of pumps and piping.

City water has been much used for refrigeration condensers. Recently, however, in some localities the supply has been restricted. Unfortunately, this restriction

† Carrier Engineering Corporation.
Illustrations courtesy of Cooling Tower Company, New York.

is imposed during the height of the cooling season when refrigeration is most necessary. In this connection, the designer should bear in mind that even though city water may now be available, there may be a limitation at some future date within the expected life of the plant.

Due to the possible shortage of water supply, and in some cases to the high cost, methods of cooling and storing condensing water have been developed. For cooling the water, various evaporative cooling devices are available. They all operate on the same principle, viz: exposing large surfaces of water to air currents, the cooling being effected both by direct contact of the cooler air with the hot water, and by the evaporation of part of the water.

Under ordinary operating conditions for refrigeration condensing, the removal of heat from the water in the cooling apparatus depends to only a small extent on conduction and radiation of the heat to the cooler surroundings, and the major portion of the heat is removed by evaporation of a portion of the water being cooled. For example, to evaporate 1 lb. of water at 100°, about 1035 B.t.u. are required—enough to cool 100 lb. of water through a range of approximately 10°. For each 10° cooling effect, roughly, 1% of the water is lost in evaporation.

The rate of evaporation and, therefore, of cooling, depends upon the following:

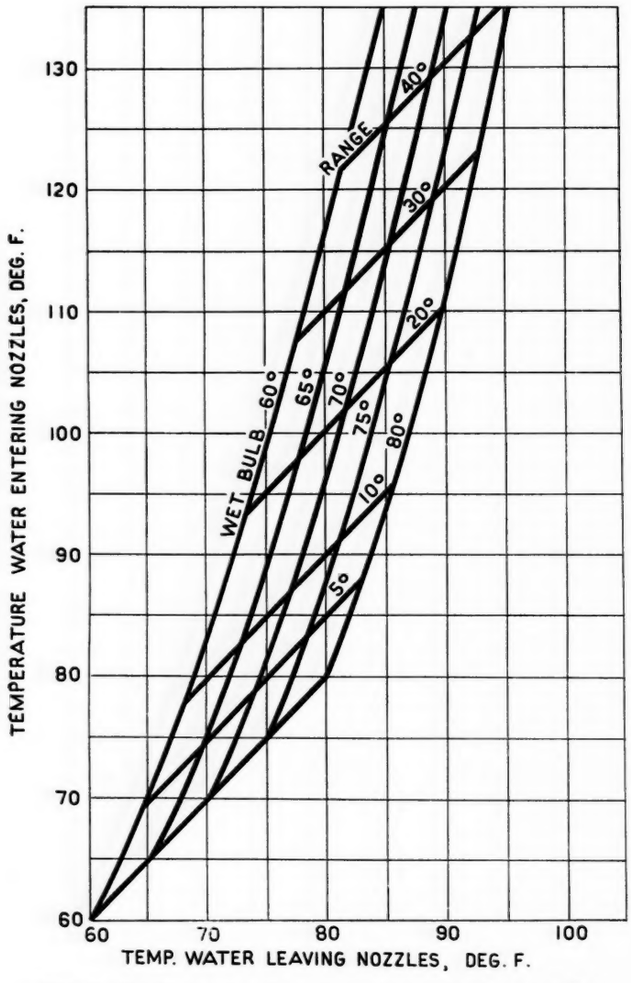


Fig. 2. Cooling curve for ammonia condensing service

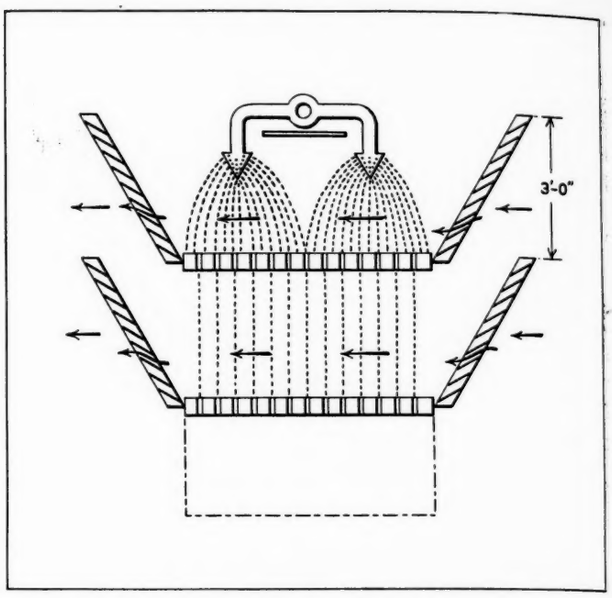


Fig. 3. Diagrammatic section through an atmospheric cooling tower

(1) Surface of water exposed to the atmosphere.
(2) Velocity of wind, carrying off saturated vapor in atmosphere.
(3) Dry bulb temperature of the air.
(4) Wet bulb temperature of the air.
(5) Length of time of exposure of water to air.

Factor (1) depends upon the type and design of the cooling apparatus, as does factor (5). Factor (2) depends upon wind velocity with atmospheric towers and spray ponds, and upon fan characteristics with forced draft towers.

The third and fourth factors are natural variants with season, geographical location and meteorological conditions. A previous article discussed the total heat of air and how the wet bulb temperature is an index of the total heat without regard to the dry bulb temperature.

Among the various types of water cooling systems now in use we find the cooling pond, spray pond, atmospheric cooling tower, fan draft cooling tower, and forced draft cooling apparatus.

The Cooling Pond

Where unlimited space is available, requirements relatively small, and low ranges in temperature differentials apply, a cooling pond or reservoir without sprays may be used to cool condenser water.

For the rate of evaporation from the pond or reservoir, in still air, the following formula, according to Box, may be used.

$$G = (240 + 3.7t)\ (P_s - P)$$

where,

G = grains of moisture evaporated per sq. ft. per hr. (7000 grains = 1 lb.)
t = average temperature of the water in degrees F.
P_s = pressure of saturated vapor in inches of mercury, corresponding to temperature t
P = the actual vapor pressure of the air in inches of mercury

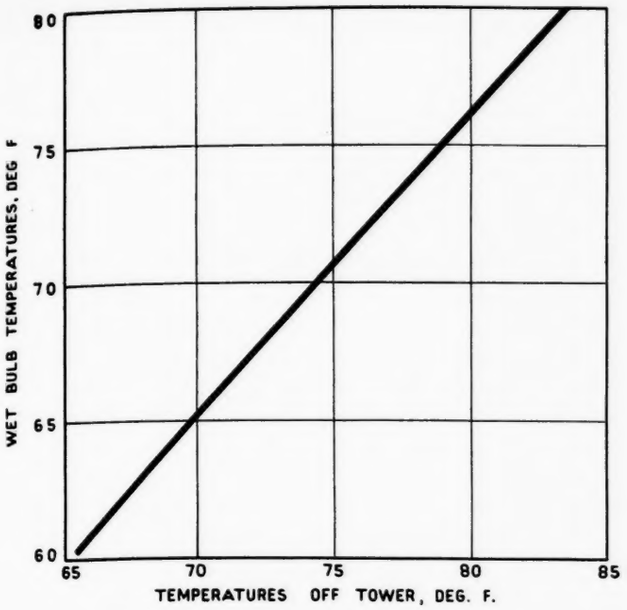


Fig. 4. Refrigeration cooling graph. Based on a wind velocity of 5 m.p.h. or over.

For the average summer conditions, ponds without sprays dissipate approximately 4 B.t.u. per sq. ft. per hr. per degree difference in temperature between the air and water temperature, depending somewhat on the differential.

In designing a pond, its maximum depth need be but 3 ft. The inlet pipe should be submerged at least 6 ft. below the surface in an inlet well, and the suction well should be provided with removable screens with submerged openings to prevent short circuiting of the hot surface water.

Example: Required to cool 100 g.p.m. with inlet temperature at 95° and suction temperature of 85°, then

$$t = \frac{95 + 85}{2} = 90°$$

Assume 80° dry bulb and 75° wet bulb (= 80% relative humidity) atmospheric conditions. Then P_s = 1.421 in. mercury at 90° (from steam tables) and P = 1.0314 × 0.80 = 0.825 in. of mercury at 80% relative humidity. Then, G = (240 + [3.7 × 90]) (1.421 — 0.825) = 342 grains per sq. ft. per hr.

To evaporate 1 lb. of water from and at 90° requires the addition of 1041 B.t.u. (from steam tables). Since

$$342 \text{ grains} = \frac{342}{7000} = 0.049 \text{ lb. of water,}$$

0.049 × 1041 = 51 B.t.u. per sq. ft. per hr. heat loss by evaporation from surface of pond.

This corresponds to

$$\frac{51}{95-85} = 5.1 \text{ B.t.u. per sq. ft. per hr. per degree.}$$

Then, 100 × 8.33 × 10° × 60 = 499,800 B.t.u. per hr. are required to cool 100 gal. (833 lb.) of water, 10° in 60 min. (1 hr.)

Therefore,

$$\frac{499{,}800}{51} = 9{,}800 \text{ sq. ft.}$$

is the area required for the pond or reservoir. The per cent loss by evaporation is

$$100 \times \frac{9800 \times .049}{49{,}980} = 0.963\%, \text{ say } 1\%.$$

Spray Ponds or Reservoirs

Where unlimited space is not available and the requirements are relatively large, either spray ponds or cooling towers are required for the cooling of refrigeration condenser water. Spray ponds will first be discussed.

In spray ponds, water is pumped through nozzles and forced into the air, the spray water contacting intimately with the air, and then descending into a pond. To prevent loss of water by windage, a louvered fence may surround the pond.

Spray ponds, like atmospheric cooling towers, are located either on the ground or roof, where they are exposed to the prevailing summer winds, but they oc-

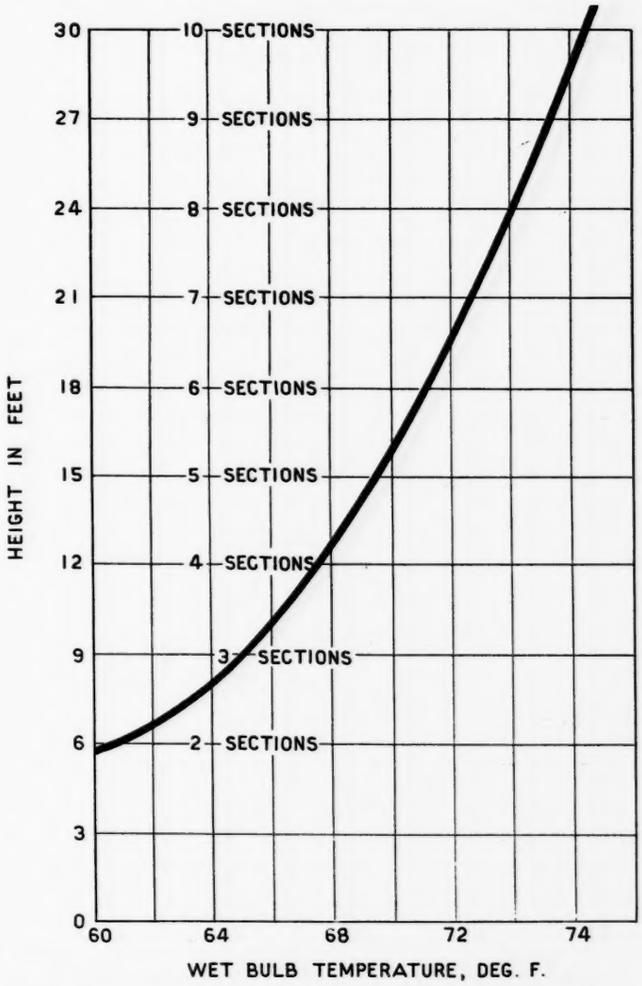


Fig. 5. Chart for determining number of sections and height of atmospheric towers. Based on 13 ft. deck width. Loading—1.5 g.p.m. per sq. ft. active horizontal area. Cooling — 90°-80° with 5 m.p.h. wind. Decks 3 ft. apart vertically.

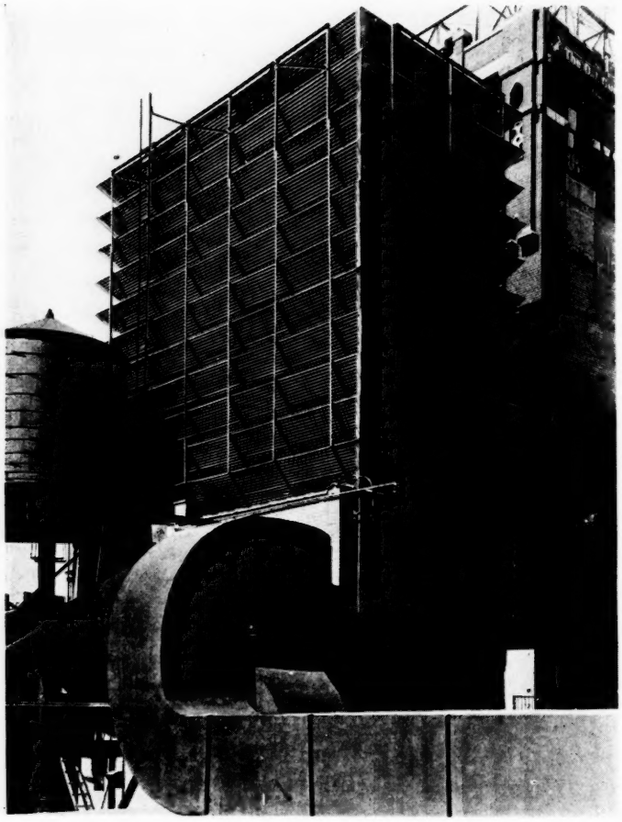


Fig. 6. An atmospheric cooling tower not architecturally treated

cupy more space for equal capacities. They also cool less efficiently than atmospheric cooling towers, due to the shorter time the water is exposed to the air.

As many spray nozzles should be provided as are required to discharge the entire quantity of water under a pressure ranging from 5 lb. to 10 lb. The average working pressure recommended by the nozzle manufacturers is about 7 lb. gauge.

The several manufacturers of spray nozzles furnish tables of capacities of the nozzles, according to size and working gauge pressure. Table 1 is an example of such ratings.

TABLE 1

Pipe Size, In.	Pressure in Pounds Per Square Inch								
	5	6	7	8	9	10	12	15	Orifice, In.
	Capacities in U. S. Gallons Per Minute								
2	33.8	37.0	40.0	42.7	45.3	47.7	52.3	58.5	1¼
1½	21.1	23.2	25.0	26.8	28.3	29.9	32.7	36.6	1
1½	16.9	18.5	20.0	21.4	22.6	23.9	26.2	29.2	⅞

To determine the number of nozzles required, divide the gallons per minute of water to be cooled by the recommended rating for the size and pressure selected.

Assume a 500 g.p.m. pond having 20 nozzles, a temperature of 92° entering the nozzles, and a temperature of 82° leaving the nozzles, with atmospheric conditions of 80° dry bulb, and 75° wet bulb (80% relative humidity).

Referring to Fig. 1, it will be seen that a 10° range is accomplished at the above conditions which balance the differential 92°-82°.

The water lost by evaporation can be calculated as follows:

$500 \times 8.33 \times (92\text{-}82) \times 60 = 2{,}499{,}000$ B.t.u. required to be removed to cool the water.

The average temperature of the water is

$$\frac{92 + 82}{2} = 87.$$

The heat required to evaporate 1 lb. of water from and at 87° is 1043 B.t.u.
hence,

$$\frac{2{,}499{,}000}{1043} = 2390 \text{ lb. of water evaporated per hr.} =$$

$$\frac{2390}{8.33 \times 60} = 5 \text{ g.p.m. (approx.) make-up water,}$$

neglecting windage loss.

Thus, it will be seen that about 1% of water is lost in evaporation, which reduces to approximately 0.1% per degree of range cooled. The windage loss is ordinarily assumed as 1%.

The area of the spray pond has but little to do, directly, with the evaporation of the water, or the resultant cooling of the circulated water. The dimensions, as to spacing of the nozzles, the space around the spray section, and other details, are the result of experience and have been determined for mechanical, rather than thermodynamic reasons.

Nozzle ratings are usually based on a 5 m.p.h. wind, which is about as low as would be expected. It is assumed that the higher velocities more than offset the absorption of solar heat in the pond surface, since the pond, with any wind movement across it is, in a sense, an atmospheric cooler in itself. Since considerable spray may be carried away by high winds, louvered fences should be installed.

Cooling Towers

Cooling towers may be generally classified as (1) atmospheric, (2) chimney or natural draft, and, (3) mechanical or forced draft types.

In air conditioning, the chimney, or natural draft type, is not usually applicable, since its operation depends upon a temperature of water "on" the tower considerably in excess of the temperatures usually met with in the cooling water for air conditioning refrigeration condensers.

Atmospheric cooling towers are designed to provide a finely divided downflow of water and a horizontal undirectional cross current flow of air, the air flow being in the direction of the prevailing wind. Fig. 2 is a diagrammatic indication of a section through such a tower.

For the purpose of refrigeration condenser water it is estimated that a load of 1½ gal. of water per sq. ft. of active horizontal area is most effective for this type of tower. With an average of approximately 3 gal. of water per min. per ton of refrigeration, to find the required active horizontal area, multiply the tons of refrigeration by 2.

For other values of gallons per minute of water per ton of refrigeration, divide the gallons per minute per ton by 1½ and multiply the result by the number of tons of refrigeration to obtain the horizontal effective area for this type of tower.

It is also necessary to specify the temperature range and the maximum wet bulb temperature under which the tower is to function.

Example: Select a tower when the refrigeration tonnage is 50, and the average water requirement is 3 g.p.m. per ton. The wet bulb is taken at 75°, and a 10° range is desired.

Referring to Fig. 3, note that the load factor is 1½ gal. per sq. ft. of active horizontal area.

$$50 \times 3 = 150 \text{ g.p.m. required.}$$

$150 \div 1.5 = 100$ sq. ft. active horizontal surface required. A tower with this rating would handle 150 g.p.m. for a 10° range, 75 g.p.m. for a 20° range, and 300 g.p.m. for a 5° range, but this always equals 50 tons of refrigeration for the tower rating.

On Fig. 3 note that at 75° wet bulb the temperature of water "off" the tower is 79°, which is 4° above the wet bulb.

From Fig. 4 note that at 75° wet bulb and 10° range the "off" temperature is 70° (checking Fig. 3), and that the "on" temperature is 88°.

Refer to Fig. 5 and note that for 75° wet bulb, 9 sections in height of this type tower are required. For this type of tower the height of each section is 3 ft.

In many large cities, code requirements demand that cooling towers be built of incombustible material, with the exception of the distribution and splash decks and the slat construction.

For both atmospheric and mechanical draft towers, the water pressure at the distribution sprinklers is usually about 2 lb. gauge.

Mechanical or forced draft towers are also termed fan towers. The draft may be either forced or induced.

As in the atmospheric tower, the warm water from the refrigeration condenser is pumped to the top of the tower, where it is sprayed over the distribution deck by means of distribution sprinklers.

The water trickles down staggered slats contacting on its downward path with the upward moving air. The air passes up in a vertical counterflow direction, zig-zagging up between the slats. The warm water is cooled and the cool air is warmed and its vapor content increased. The air leaves the tower in a nearly saturated condition.

Fundamentally, the difference between an atmospheric and a fan tower is in the difference of air flow, that of the atmospheric tower being a variable velocity horizontal transverse flow, while that of the fan tower is a fixed velocity vertical counterflow.

Digressing for a moment, it is well to note that the effectiveness of a water cooling system is roughly proportional to the intimacy and length of time in the contact between the air and the water particles. From this it can be seen that the least effective is the cooling pond without sprays; that next in effectiveness is the spray pond with the atmospheric cooling tower a slightly better apparatus, while the fan tower is the most effective.

Fig. 6 is a section through a typical fan tower, and also shows a detail of the slat arrangement.

Because of the greater length of time in the contact of air and water in the fan tower cooler the gallon per square foot loading is greater. This ultimately results in the fact that this type requires less area than the atmospheric type and is, generally speaking, the prime reason for its selection where space is at a premium and local conditions warrant its selection.

Although, because of the mechanical control of the water and air, the loading per square foot may be varied, the average rating is assumed at approximately 3 g.p.m. per sq. ft. Towers can be purchased with pumps and fans driven by variable speed motors giving a flexible and wide range. Fig. 7 is based on a 2.58 g.p.m. loading. The horizontal effective area would be the gallons per minute to be cooled divided by 2.58. The air to water ratio for this particular model is 1.2. The velocity of air is established at 700 f.p.m., so that the net free area will be the total cubic feet per minute divided by 700.

The formulations are as follows:

t_1 = temperature of water on tower
t_2 = temperature of water off tower
t = temperature of wet bulb of air entering tower
$t_1\text{-}t$ = maximum possible drop in temperature of water
$E\ (t_1\text{-}t)$ = drop that may be ordinarily obtained

$$E = \text{efficiency} = \frac{t_1\text{-}t_2}{t_1\text{-}t}$$

Q_1 = heat content of entering air above 0°
Q_2 = heat content of leaving air above 0°
W = weight of water to be cooled per minute, pounds
w = weight of air to be circulated per minute, pounds

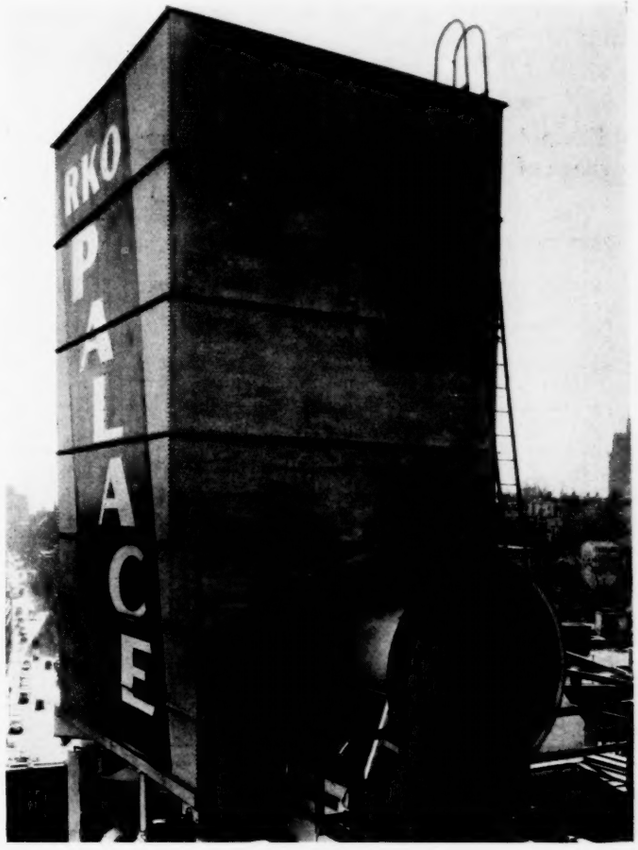


Fig. 7. A metal fan draft cooling tower

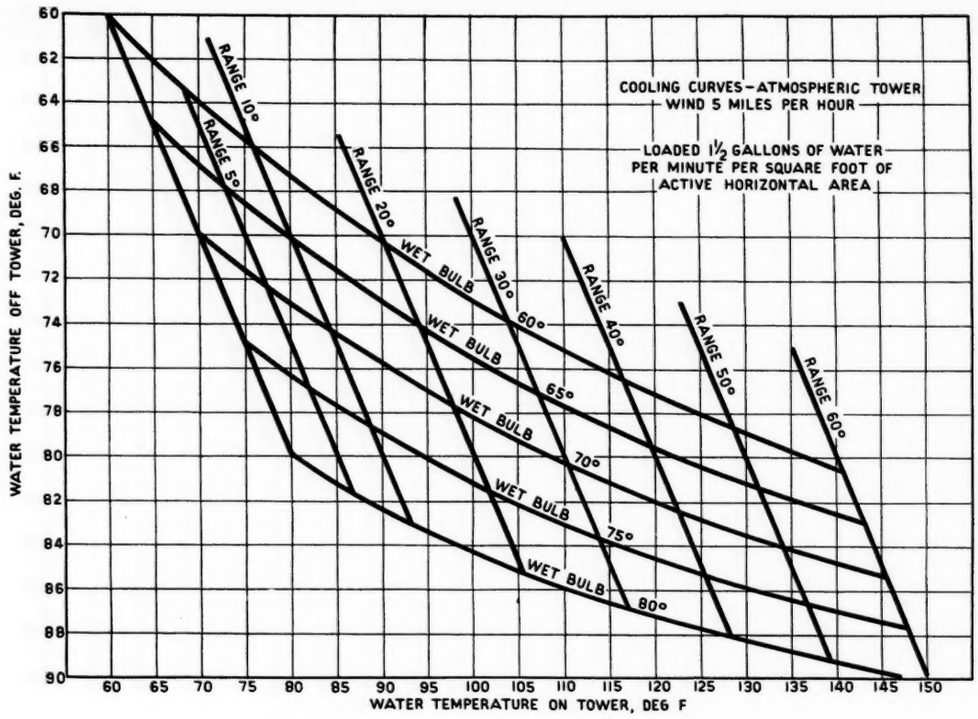


Fig. 8. Cooling curves for standard atmospheric tower.

d = density of air at dry bulb temperature of entering air

C = cubic feet of air at dry bulb temperature of entering air

Then,

$$w\ (Q_2-Q_1) = W\ (t_1-t_2)$$

and

$$w = \frac{W\ (t_1-t_2)}{Q_2-Q_1}$$

and

$$C = \frac{w}{d}$$

Example: With a wet bulb temperature of 75°, and a range of 10°, determine the final or "off" tower water temperature. Refer to Fig. 7 and find that 80° is the approximate "off" temperature. The "on" temperature would then be 90°.

Solution:

$$t_1 = 90°,\ t_2 = 80°,\ t = 75°$$

$$t_1-t = 90° - 75° = 15°$$

maximum possible drop in temperature of water. Assume an efficiency of 73½% as applicable to a well designed tower.

$$E\ (t_1-t) = 0.735 \times 15 = 11°$$

then, 75 + 11 = 86°, temperature of air leaving top of tower. Assume the air to be 85% saturated.

Q_1 = total heat per pound dry air at 75° wet bulb = 37.75 B.t.u.

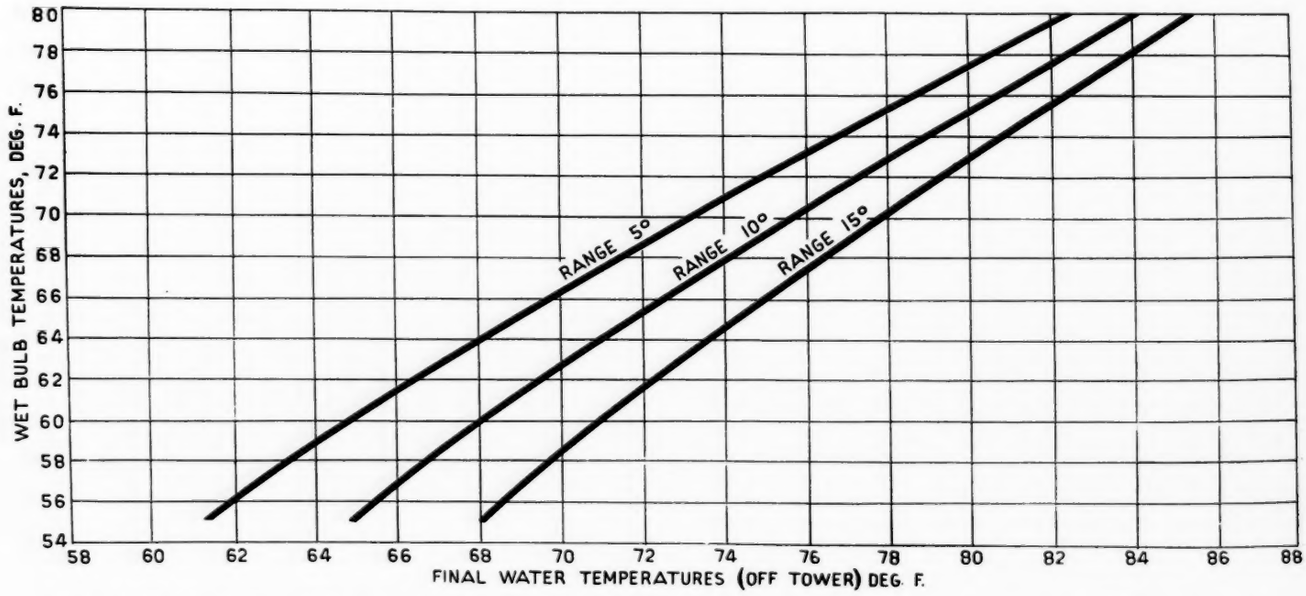


Fig. 9. Cooling curves for mechanical draft cooling tower. Based on a 2.58 g.p.m. loading, an air to water ratio of 1.2, and an air velocity of 700 ft. per min.

Q_2 = total heat per pound dry air at 84° wet bulb (corresponding to 86° dry bulb, 95% relative humidity)
= 46.65 B.t.u.

Assume 500 tons of refrigeration × 3 gal. per ton = 1500 g.p.m. water to be cooled.

$$w = \frac{W\,(t_1-t_2)}{Q-Q_1} = \frac{1500 \times 8.33\ (90\text{-}80)}{46.65 - 37.75} = 14{,}050$$

lb. air required.

The density of air saturated at 75° is approximately 0.072.

Therefore, $\frac{14050}{0.072}$ = 195,000 c.f.m. required, approximately.

Assuming a velocity of 700 ft. per min. over the net area, and a tower based on 50% free area, the area of tower required is $\frac{195{,}000}{700 \times 0.5}$ = 560 sq. ft.

This checks fairly close to the area indicated by the method previously explained, by which we find the tower area to be 1500 ÷ 2.58 = 580 sq. ft.

The height of a tower for such operation would be about 30 ft., including allowance for a suitable fan and distributing decks.

One or more fans may be selected to force the 195,000 c.f.m. through the tower. For example, two impeller blowers 7 ft. in diameter may be used, which, assuming a static pressure loss of approximately ⅝ in. (common for such a tower), will require about 20 brake horsepower each. Hence, two 25 hp. motors will be necessary to drive the fans.

Much of the design of mechanical draft cooling towers is based on theoretical thermodynamic calculations augmented by performance tests on previous towers of similar nature. As is true when selecting pumps, motors, fans, and similar equipment, it is well to consult reputable manufacturers when confronted with a problem of cooling condenser water.

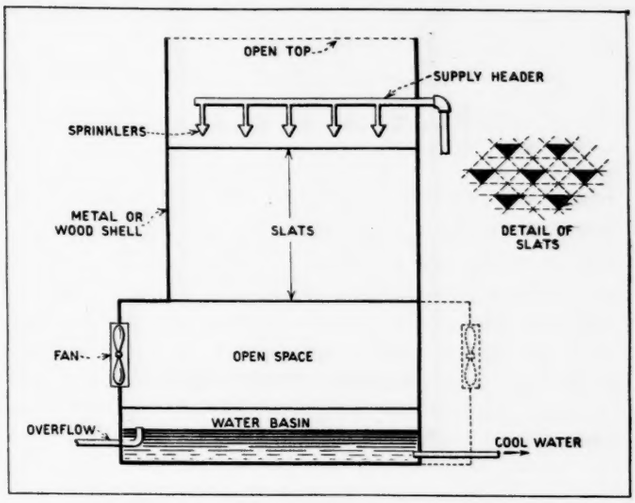


Fig. 10. Section through a typical fan tower

Forced Draft Condenser Water Coolers

Recently there has been developed a type of forced draft condenser water cooler which is composed of an air washer and fan assembly. Such an apparatus may be placed in any location where air is readily available. It is not necessary to have roof space and there are no undesirable effects caused by the carrying over of water spray into the streets or adjacent buildings. Although the capacities and make-up water quantities may be roughly calculated by methods used for other types of cooling towers, much of the design data is based on empirical formulas resulting from tests.

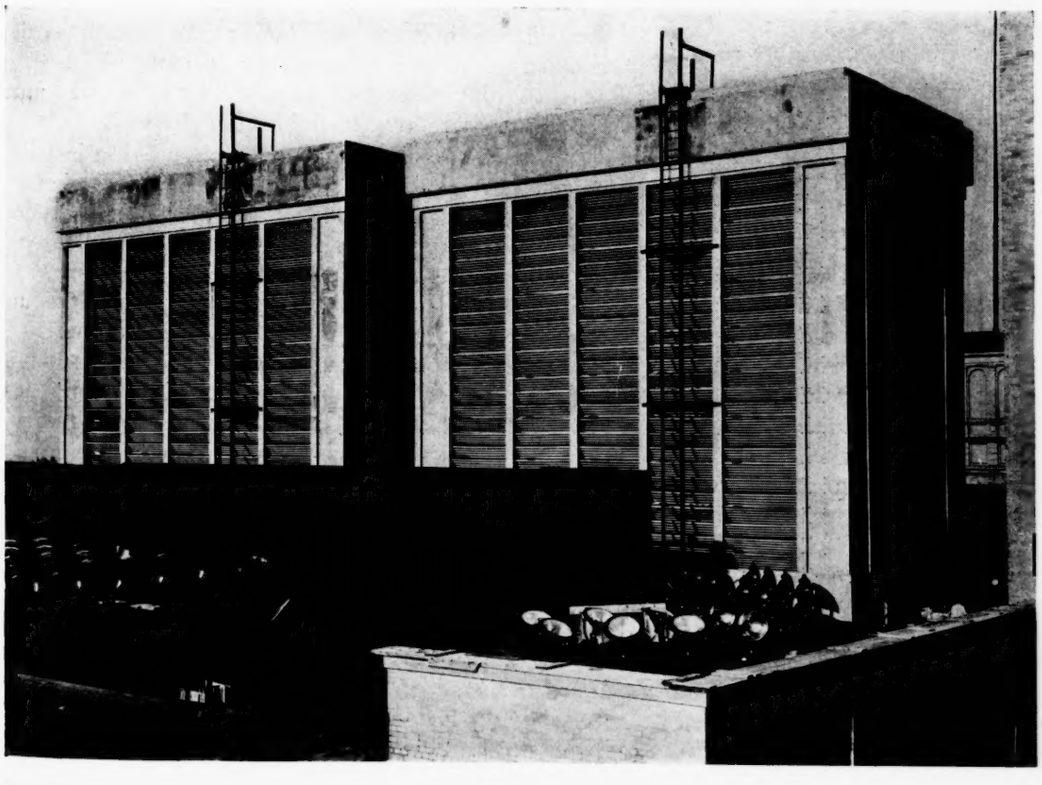


Fig. 11. An atmospheric cooling tower architecturally treated.

Your Everyday Problems

Mr. Hanburger will be glad to answer your problems relating to installation and operation of heating and ventilating systems, and wherever possible will give the reasons for his suggestions. Letters will be answered direct to the inquirer and in some cases published anonymously. If sketches are included they should be clearly drawn. Write Mr. Hanburger, HEATING AND VENTILATING, 148 Lafayette Street, New York.

Conducted by FRED W. HANBURGER

QUESTION 38. Nearly every heating contractor, at some time in his experience, has had trouble with a new heating plant where he suspects the trouble to be with the draft, but cannot always prove it to the owner. It may be a down-draft condition, or a small flue, but in either case it is rather expensive experimenting with additions to the chimney. Can you tell me whether or not there is a draft gauge on the market, by the use of which a contractor could tell before installing the job, whether or not the draft available is sufficient to make the boiler work properly? I suppose it would make a difference whether bituminous or anthracite coal was used, and also what size, as buckwheat or chestnut would require more pressure than stove or egg-sized coal. Draft troubles are frequent in residential work, and I am wondering if it is possible to forestall such problems.

What is the rule, if any, governing the pipe sizes of drips or bleeders that are cut in on the mains near the boiler for the purpose of equalizing the pressure in steam jobs?

What special precautions, if any, should be taken in installing unit heaters on a hot water system? Is a circulating pump necessary? What temperature should the water be in the unit heater at all times to prevent cool air being blown down from overhead? It seems to me that a circulating pump and a large-sized boiler would be essential to maintain the correct water temperature in the unit heater.

Interested Reader.

ANSWER. It is not only difficult to sometimes prove to the owner that the draft is insufficient but it is sometimes difficult to so prove it to our own satisfaction. I do not know of any gauge or instrument to test the chimney before installing the heating plant and feel rather positively that there is none. After the system is installed the gauge reading taken at the fire door should show approximately 0.01 in. of water per pound of coal burned per hour per square foot of grate surface. The various rules of practice for estimating the size of the chimney are based to produce approximately this amount. However, many contractors install a boiler greatly in excess of the required size when the chimney becomes inadequate, or if the chimney is of ample size, the combustion rate per square foot of grate falls so low that the boiler must idle along, so that soot is collected in the flues, breeching and chimney. The technical reasoning for determining the size of the chimney follows simply along the laws of hydraulics, but there are so many factors involved, such as the type of boiler used, type of grate, kind of fuel, construction of chimney, etc., etc., as to render the reasoning almost useless. A practical method is given below which, if followed, should avoid the annoyances you speak of.

With a chimney height up to 50 ft., allow 5 lb. of coal burned per square foot of grate surface. For a 60 ft. height, 6 lb., for 70 ft., 7 lb., etc.

By allowing 32 sq. ft. of radiation for each pound of coal the grate surface may be ascertained. The area of the chimney (in square feet) needed can then be estimated from the formula:

$$\text{Area of chimney} = \frac{\text{Grate area in sq. ft.}}{\sqrt{\text{Height of chimney}}}$$

Thus, in a 6-story building, with a heat loss of 6000 sq. ft. of radiation and a chimney height of 70 ft., we can allow 6 lb. of coal per square foot of grate which would be equal to

$$6 \times 32 = 192 \text{ sq. ft. of radiation.}$$

The boiler should then have a grate area of

$$\frac{6000}{192} = 31.3 \text{ sq. ft.}$$

and the area of the chimney should be

$$\frac{31.3 \text{ sq. ft.}}{\sqrt{70 \text{ ft.}}} = 3.77 \text{ sq. ft., or } 542 \text{ sq. in.}$$

which would mean a chimney 23 in. x 23 in.

The only purpose of a drip or bleeder from the main is to take care of what condensation it may form. A long header will, therefore, need a larger drip. As a general rule they are made larger than actually needed. A basis of reasoning would be to make the size the same as that of a wet return, taking care of as much radiation as the area of the header drained.

No special precautions need be observed in installing unit heaters on a hot water system except that the piping be sufficiently large. All unit heater catalogs give the capacity in equivalent radiation, and the piping must be sized to accommodate this the same as for the other radiators on the system. When the unit heaters are located on the lower floors the tappings will sometimes be found to be too small and must again be compensated for in the piping when this is possible. If you have a particular installation in mind and will send me the details, I may be able to help you. Where properly installed a circulating pump is not an absolute necessity.

QUESTION 39. Will you tell me of a moderately-priced effective instrument or apparatus for humidifying the air in a small house? I have an eight-room house and have every radiator covered with metal pans containing a gallon of water in each, and still the air is quite dry.

It seems to me that the next development on a scale as great as the recent expansion of electric refrigeration for the home will be the cooling of homes in the summer and the humidifying of the homes in the winter. The system, or method, must be simple, effective and priced no higher than a moderately-priced radio.

Do you know what is the best way of treating or insulating the upper part of a house so that the upper rooms will not be cold in winter? My house has an unfinished attic and an inverted V roof.

Would you suggest putting down an ordinary floor, or a floor of insulating board or some such product, or would you line the rafters on the sides, or pour mineral wool in the floor? *B. I.*

ANSWER. There are many admirable moderately-priced humidifiers on the market. It is not possible for me to recommend any particular one in this article but you can easily make a selection from the advertisements that appear in these columns from time to time. It is also probable that after this article is published I will receive circulars to be forwarded to you.

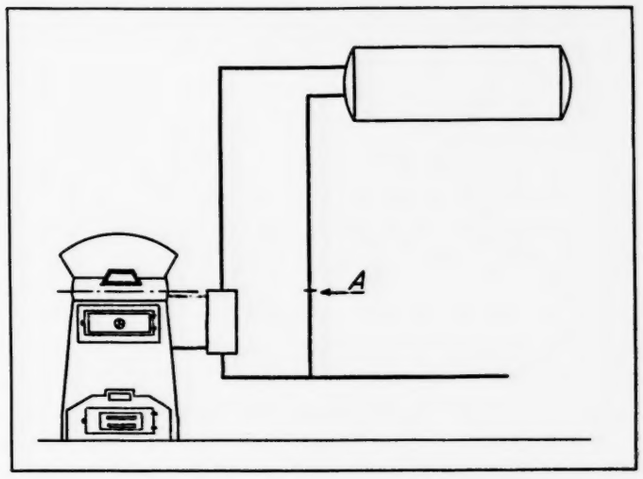
An open pan on the radiator will not evaporate sufficient moisture properly to humidify the air as there is not enough circulation of the air over the surface of the water. Allowing one air change per hour an ordinary room will require, roughly, 1 gal. of moisture evaporated per day in winter weather, and I fear that you do not get much more than that many thimblefulls with the open pans.

The idea of cooling the air in our homes during the summer months is making rapid advances, and I think that you may be interested in my answer to M. F. in the March, 1932 issue.

By insulating your attic you will note a vast improvement both in winter and in summer. If the attic is used as a storeroom it should have a floor, but even with a floor it is well to line the rafters and studding.

QUESTION 40. We have just installed a submerged domestic hot water heater in a five-story apartment building housing 24 families. In a test during the recent cold spell it required five hours intensive firing before any pressure was shown in the boiler. In the coldest weather during last winter before the submerged heater was installed, pressure was generated readily. There are 980 sq. ft. of cast iron radiation in the building, and the boiler is a ..... pattern, which is conservatively rated at 2400 sq. ft. of cast iron radiation. This should easily take care of the added hot water burden. The storage tank could not be placed in the cellar and was located in a vacant space on the first floor. It has a capacity of 1000 gal. I would like to make any necessary changes before the extreme cold weather arrives. *L. O. N.*

ANSWER. The type boiler you mention has a grate area of 10 sq. ft., and with a five-story chimney height could be depended upon to furnish approximately 2000 sq. ft. of cast iron radiation. Allowing a hot water demand of 10 gal. per family calls for a total of 240 gal., which is equivalent to 960 sq. ft. of cast iron radiation. You will note, then, that the boiler can just nicely take



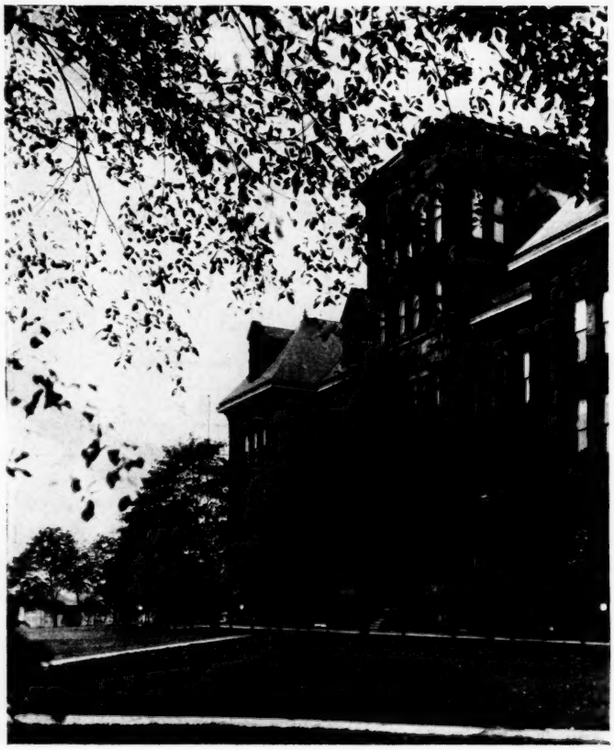
care of the two loads. The cause, or rather causes, of your trouble is an excessively large storage tank and its extreme height above the heater, which is possibly around 7 ft. or 8 ft. This extreme height generates considerable power, producing a rapid circulation between the tank and heater, and especially so if you have used full sized piping to fit the connections for such a large tank. This circulation allows the tank to continually present its coldest water to the heater, and as the transfer of heat from water to water is very rapid, all the water in the tank must be heated before that in the boiler becomes hot enough to generate steam. The boiler itself contains somewhere between 100 gal. and 200 gal., but adding 1000 gal. more creates an added load which will take the boiler hours to overcome.

The best suggestion I can offer, and one that has cured many similar cases where it was wrongly felt that a large storage tank was beneficial, is to insert a lock-shield gate valve at the point marked A in the drawing. This can then be adjusted on the initial firing to have the time to heat the water in the tank spread over 8 hr. or 10 hr., and permit most of the heat to go toward heating the building.

QUESTION 41. I have just finished a one-pipe steam heating job and laid out the pipes, allowing only 1 oz. loss per 100 ft., which I understand is considered good practice, but it has turned out to be very noisy with water hammer. *E. C. R.*

You have not given any details, but I suspect very much that the trouble lies in the branches both to the risers and to the radiators themselves. Many of these branches will not bear a loss of 1 oz. per 100 ft., due to the fact that the steam flow becomes too rapid and carries along the water of condensation. This is the reason for the old practical rule that the branches to risers should usually be one size larger than the risers themselves. The branches should be sized not so much as to the friction loss per unit of length, but rather to keep the velocity of the steam below that at which it will carry along the water of condensation. The branches should also have a minimum pitch of 1 in. in ft. Poorly-sized branches have so often been the cause of annoyance in steam heating systems.

Technical Papers Feature Air Conditioning Conference



Main building, Case School of Applied Science, Cleveland, Ohio.

APPROXIMATELY 400 engineers, from ten states and Canada, attended the conference on air conditioning, sponsored by the Cleveland Engineering Society and the Case School of Applied Science, held in Cleveland, Ohio, March 17-19. The conference was in the nature of a symposium and covered recent developments in summer and winter conditioning of indoor air, and also the economics of the human comfort phase.

At the opening session, March 17, T. A. Weager, district manager of the Buffalo Forge Co., Cleveland, discussed "The Use of Psychrometric Charts." Mr. Weager described the construction and use of the Carrier chart, and also referred to the Labus chart.[1]

M. F. Rather, Cleveland manager, Johnson Service Company, discussed "Automatic Regulation in Air Conditioning." In the discussion on Mr. Rather's paper it was stated by a discusser that it was impossible to maintain temperature differences at ½ of 1%. This was said to be due to the growth of algae on the wicks used in wet bulb readings. There was no answer to the question whether anyone had discovered a means of overcoming this condition.

"The Reversed Refrigeration Cycle for Summer and Winter Air Conditioning" was the subject of a paper by R. E. Keyes, chief engineer, Cooling and Air Conditioning Corporation. Mr. Keyes made reference to the installation in the Southern California Edison Building, Los Angeles.[2] Mr. Keyes stated that the efficiency of the heat pump may run as high as 400% under very favorable conditions. The system can be applied to best advantage to low temperature heating requirements, such as might be needed for humidifying and heating fresh air supplied to the building, under which conditions of operation it can be accomplished under relatively low condensing temperatures.

At the evening session, March 17, W. A. Schmid, Jr., research engineer, City Ice & Fuel Co., Cincinnati, Ohio, discussed "Space Cooling with Ice." The author described several ice cooling installations as follows:

"In order to illustrate the flexibility of ice, conceive, if you can, of an air cooling load through the coil or washer of 500 tons of refrigeration. Assume that this much cooling effect, equivalent to 500 tons of refrigeration, is required for only 5 min. If a refrigerating machine were installed in place of the ice melting tank, the necessary investment for this load would be approximately $150,000, and the same effect could be obtained by melting 3125 lb. of ice in 5 min. in the melting tank. This is based on water leaving the washer at 48° and each pound of ice is, therefore, capable of taking up 160 B.t.u. The complete cost of the ice melting tank and ice would not exceed $500. This case, of course, is not likely to be found in practice. Assume now, that the 500 ton refrigerating effect is needed for 5,000 hr. a season instead of 5 min. No comfort cooling job in this latitude requires refrigerating effect for 5,000 hr. per season. Therefore, this, too, is an extreme case not to be found in practice and taken for illustration only. The same $150,000 refrigerating machinery would do this job, but it would take 93,750 tons of ice. At the present-day market, such a quantity of ice delivered to one convenient point could probably be sold for $2.50 per ton, perhaps less. The cost of ice in this case would be $234,375, and the cost plus the fixed charges of the melting equipment would be greater than the fixed charges on the machine plus cost of operation. Both of these cases are exaggerated. The 5-min. period is grossly in favor of ice, and the 5,000-hr. period is grossly in favor of the machine with ice prices at the present level. There must be a point somewhere between these two extremes below which ice at present price will be the cheapest method and above which the machine will do the job most economically.

"When conditions are such that the ice manufacturer can afford to sell his ice for $3 per ton, ice is cheaper on the job that needs cooling for 1,000 hr. or less. When, because of conditions, ice has to be sold at $5 per ton, 500 hr. is the breaking point between machine cost and ice cost.

"Any job that requires 700 hr. or less for cooling is most economically done with ice even at $4 per ton. A job requiring between 700 hr. to 1,000 hr. is a toss-up

[1] See "The Labus Psychrometric Chart," by C. O. Mackey, page 40, and the "Use of the Labus Chart for Air Conditioning Operations," by K. P. Brace, page 43, HEATING AND VENTILATING, March, 1932.

[2] See "An Electrically Heated Office Building," HEATING AND VENTILATING, September, 1931, page 49.

between ice and a machine, but ice is still cheaper if the price of ice is down to $3 per ton. Anything over 1,000 hr. is in the range of the machine unless the price of air conditioning ice can be brought down.

"Think of the vast number of potential air cooling jobs that require 800 hr. and less of cooling per season. One large manufacturer of ventilating equipment shows by a graphic study of 1930 wet and dry bulb temperatures in the City of New York, that there were only 21 days in which cooling by refrigeration was actually necessary for comfort. There were, of course, more than 21 days in which the dry bulb temperature was over the comfort point, but on these days the wet bulb temperature was low enough for evaporative cooling. Therefore, according to this data, if the hundreds of small neighborhood theaters in the same temperature zone as New York were to install a ventilating system with an air washer, they could cool their houses to the comfort zone, on all but 21 days of the summer, by evaporative cooling in the washer."

"Problems of Power Supply for Air Conditioning" was the title of a paper by R. E. Hellmund, chief electrical engineer, Westinghouse Electric & Mfg. Company. Mr. Hellmund talked chiefly of power rates and the possibility of a peak load in summer months and the consequent need for the utility to maintain generating equipment which would be idle several months a year. This would be reflected in an increasing power rate. The author felt that more quiet operation will be required.

S. B. Heath, development engineer, Dow Chemical Company, presented a technical paper on "Dehumidification with Calcium Chloride," and explained some of the theoretical possibilities of calcium chloride for conditioning air, as indicated by the physical properties of calcium chloride, both solid and in solution, and explained the development of equipment built to apply these principles.

M. K. Arenberg, Chicago district manager, Ilg Electric Ventilating Company, presented a paper on "Cooling for Profit." Abstracts from his paper follow:

"One example of unit cooling is a restaurant of the luncheonette and soda type. It is 21 ft. wide, 112 ft. long and has a 15 ft. ceiling, or a volume of 35,280 cu. ft. The seating capacity is 110. It has been in business many years, but did not install a cooling system until June, 1931. During the past summer, the average daily receipts increased $148, and the management stated that at least 100 persons were turned away each day at noon because all tables were taken and no standing room was available. This restaurant advertised quite regularly in the daily newspapers to keep its name before the public, but no mention of the cooling system was ever made, because the word of mouth publicity of their patrons was sufficient to keep them crowded. The net profit on the increased gross business due to the installation of the cooling system may be estimated from the fact that 25 cents is their charge for an ice cream soda. This net profit was sufficient to pay for the cost of the complete installation.

"I believe we have all been too quick in believing that the greatest market for cooling is in the theaters and restaurants. This has probably been brought about by the fact that these two classes have been the leaders in the past in accepting proper standards of ventilating, but what about drug stores, shoe stores, ladies' ready-to-wear-apparel, millinery, men's clothing, groceries, and 5, 10, 25 cent and $1 stores?

Mr. Arenberg pointed out that unit coolers will not replace exhaust or supply ventilating systems.

At the morning session, March 18, Dr. E. Vernon Hill described "Standards of Air Quality." Doctor Hill told of experiments conducted on human beings at Johns Hopkins, in connection with the part pollen plays in hay fever.

"Natural Air Movements and Their Effect on Air Conditioning" was described by Prof. G. L. Larson, head of the department of mechanical engineering, University of Wisconsin. The author's remarks were largely confined to infiltration, where it takes place, and its effect on air conditioning. He concluded that since the capacity and cost of operation of the air conditioning plant is greatly affected by air tightness of the structure, it is more important than ever to insist on, and invest in, better building inspection.

F. C. Houghten, director of the research laboratory of the A.S.H.V.E., in his paper "Air Conditioning and Human Comfort," explained the conditions to be attained, rather than the equipment to create the desired conditions. He presented a number of slides showing psychrometric charts, relation between metabolic rates and activity, latent heat and moisture loss, etc.

Curves on power consumption, requirements for moving picture theaters, residences, and a 40-story office building were presented by J. H. Walker, superintendent of central heating, Detroit Edison Company. Much of this material was obtained from a test conducted on the operation of the air conditioning system in the Union Guardian Building, Detroit.[3]

[3] See "Field Studies of Office Building Cooling," HEATING AND VENTILATING, March, 1932, page 76.

Dr. William E. Wickenden, president, Case School of Applied Science.

Prof. F. H. Vose, head of mechanical engineering department, Case School of Applied Science, and chairman, general committee on industrial conferences.

At the afternoon session, March 18, William H. Driscoll, vice-president, Thompson-Starrett Company, expressed a belief that large buildings of the future will be less ornate and pretentious. He does not anticipate windowless buildings and sees no great future for air conditioning in large commercial buildings. In the discussion of his paper, Willis H. Carrier expressed the opinion that the lower stories of large buildings would be windowless.

Mr. Driscoll mentioned the experience of the Hotel Gibson, in Cincinnati, in connection with air conditioning its tearoom. In the summer of 1929 the room was air conditioned, and as compared with the summer of 1928, the following results were obtained:

Average increase in daily sales—45%; average increase in covers served—43%; increase in amount of average checks—22½%; increase in net profits—30%; permanent increase in patronage after summer months' operation—10%.

"The Air Conditioning of Railway Trains" was the subject of a paper by W. H. Carrier, chairman of the board, Carrier Corporation, and R. W. Waterfill, refrigerating engineer, Carrier Engineering Corporation. The authors explained the specific problems encountered in railway air conditioning, and told how they had been met.

"Year 'Round Air Conditioning with the Individual Unit" was the subject of a paper by W. D. Jordan, president, Air-Control Systems, Inc. Mr. Jordan named six factors which must be considered in conditioning a residence. In his conclusion he summarized and defined the factors, outlining minimum requirements under each. These are:

1. Air motion—Minimum of 20 c.f.m. per person.
2. Purification—Minimum of 20 c.f.m. per person, circulated through dense spray, or other means of removal of impurities.
3. Heating—Minimum of 8,400 B.t.u. available for evaporation.
4. Humidification—Evaporation of 8 lb. water per hr.
5. Cooling—Removal of 10,880 B.t.u. per hr. for 15° differential in living room.
6. Dehumidification—Removal of 2.5 lb. of water per hr.

Mr. Jordan's paper was followed by "Requirements for the Successful Unit Conditioner," by R. E. Robillard, application engineer, Frigidaire Corporation, Dayton, Ohio. Mr. Robillard outlined the advantages of unit conditioners and laid down the features which the unit conditioner should have to be successful. These included the capacity, air delivery, and space and shape requirements.

At the evening session, March 18, H. B. Meller, chief of the Bureau of Smoke Regulation, Department of Public Health, Pittsburgh, discussed "Atmospheric Pollution, Its Measurement and Control." Doctor Meller covered not only the subject of smoke, but also the other solids present in the air.

Prof. F. B. Rowley, director of the Experimental Engineering Laboratories, University of Minnesota, presented a paper on "Air Conditioning in the Home."

At the morning session, March 19, F. Paul Anderson, Dean of Engineering, University of Kentucky, read a paper on "The Human Power Plant."

"Problems of the School and Public Building," by S. R. Lewis, consulting engineer, Chicago, was presented by his son, Edward Lewis.

"Atmospheric Dust and Air Cleaning Devices" was the subject of a paper by H. C. Murphy, vice-president, American Air Filter Company. Mr. Murphy stated that St. Louis has shown the greatest improvement in smoke conditions of any of the 24 cities surveyed in 1929, as compared with 1924-1927. While Boston showed no improvement, it is still the cleanest of the cities investigated.

The concluding speaker was Eugene D. Milener, industrial research representative, American Gas Association, who spoke on "The Gas Industry's Position in Relation to Air Conditioning." He stated that, while previous speakers had emphasized the conditioning of only a few rooms in residences, he believed that a central air conditioning plant was preferable, and that, in general, cooling would cost about 40% of that for winter heating.

Manufacturers who exhibited their products at the Conference were:

Ace Humidifying Co., Minneapolis, Minn.; Owens-Illinois Glass Co., Toledo, Ohio; Air-Control Systems, Inc., Chicago, Ill.; Henry Furnace and Foundry Co., Cleveland, Ohio; Carrier Engineering Corp., Cleveland, Ohio; Cleveland Smoke Commission, Cleveland, Ohio; Independent Register Co., Cleveland, Ohio; Ilg Electric Ventilating Co., Chicago, Ill.; American Air Filters Co., Louisville, Ky.; Frantz-Carroll Systems, Cleveland, Ohio; Frigidaire Corp., Dayton, Ohio; Dow Chemical Co., Midland, Mich.; Sun Radiator Cover, Inc., Cleveland, Ohio; The Permanent Electric Co., Cleveland, Ohio.

Proposed Building Regulations for New York

A brief description of, and comments on, the heating and ventilating sections of the code.

FOR some years, the existing building code in New York has been subject to criticism on the grounds that many of its provisions are outgrown and obsolete and that builders are handicapped by many of its provisions. This complaint is an old one regarding all such codes.

After these criticisms became pointed enough to reach influential quarters, moves were made looking toward a thoroughgoing revision. As a result, the Merchants Association undertook the task of preparing a suitable code which would meet the criticism directed against the present one and which it was hoped would be so drawn as to make it permanent in nature.

In order to do away with the inflexibility which usually surrounds such codes unless they are broadly drawn, the principle of limiting the ordinance sections to empowering clauses and then depending on rules to be adopted by an administering body was accepted.

After several years of effort the proposed code is now complete and was delivered to the mayor[1] on January 14. As presented, it represents the combined efforts of several hundred people who shared in the committee work, and who represented the several interests affected. Included were many experts both from New York and elsewhere.

In its proposed form it thus represents a recent effort at code making, and while strictly speaking many of its provisions apply only to conditions peculiar to New York, still it is likely to be widely copied, and some of its provisions are of enough importance to warrant reprinting for the information of those interested even though they are not directly affected by it.

In general, in carrying out the principle of limited enactments, only the portions dealing with administrative matters, such as scope, permits, penalties for violations and enabling clauses, are recommended for ordinances. Then recommendations of suitable rules are made.

As there already exists in New York a Board of Standards and Appeals, it is assumed that it will act as the administering body, adopting such working rules as seem necessary or advisable.

[1] Mayor James J. Walker, after a careful personal study of the new code, in March gave the document to William J. Cahill, commissioner of bill drafting, with recommendation to prepare it for presentation to the Board of Aldermen. Indications point to action on the matter at the earliest possible time.

The code as proposed would include practically all new construction and remodeling undertaken in the whole greater city, except some outlying districts, and would apply to both public and private projects.

One of the interesting features is that licensed engineers or architects are required to make affidavits when filing their plans to the effect that to the best of their knowledge and belief the plans conform to the requirements, except as noted. This is a feature not hitherto required. It is intended to check any tendency toward trying to "get by" without meeting the provisions in full. A further provision that an affidavit must be made that the building as erected is in accordance with the plans and specifications, is intended to prevent the practice of altering the plans during construction—a practice which has grown up to a considerable extent.

Another provision is that when combustion apparatus is to be installed a permit must be secured. The application for the permit must be accompanied by plans showing the location, type and size of the apparatus, the stack connection, the kind of fuel to be used, the method of operation, and the method of preventing the emission of solids with the cumbustion gases. This is an attempt to fight the solid stack emission nuisance at the source.

The code as printed is divided into sixteen sections and subdivisions are arranged with decimal indexing. It is voluminous, and only those parts having to do with heating and ventilating are reproduced here.

Article 5, "Ventilation" and Article 11, "Heating Appliances, Combustion and Chimneys" are the two parts which set forth the requirements of interest to us, although Article 12 mentions briefly heating appliances for special purpose buildings.

In Article 5 the proposed code would cause but two sentences to be enacted into ordinances. These are as follows:

Structures or parts of structures hereafter constructed, shall be provided with ventilation in rooms and spaces as required by the rules of the Board.

The design and installation of the means for ventilation shall be as required by the rules of the Board.

The code recommends that the Board adopt the following rules.

(5.1.3) Where excessive heat may be created to the detriment of the occupants, or where steam, gases, vapor, dust or other impurities in the air, which may be injurious to health, may be generated in the course of commercial activities, rooms shall be ventilated in such manner as to render them harmless to any person therein.

(5.1.4) Spaces below grade without windows, and designed for human occupancy shall have a mechanical means of ventilation of at least 50 cu. ft. per person per min., and at least four changes of air per hour, with provision for a corresponding air inflow from an uncontaminated source.

(5.1.5) Every bathroom, toilet room or other room containing one or more water closets or urinals, hereafter placed in any structure, shall be ventilated in at least one of the following ways:

(5.1.5.1) By a window, opening to a street, yard or court of lawful dimension and having a clear ventilation area of at least 5% of the floor area, but at least 3 sq. ft. and a width of at least 1 ft.

(5.1.5.2) By a window of the size specified in (5.1.5.1), opening on a vent shaft which extends to and through the roof, or into a court of lawful dimensions and which has a cross-sectional area of at least 1/5 of a sq. ft. for every foot of height, but at least 9 sq. ft. and, unless open to the outer air at the top, a net area of louver openings in the skylight equal to the maximum required shaft area.

(5.1.5.3) By an individual vent flue or duct extending independently of any other flue or duct to and above the roof and having a cross-sectional area of at least 1 sq. ft. for one or two water closets or urinal fixtures and 1/3 of a sq. ft. additional for each additional water closet or urinal fixture.

(5.1.5.4) By a skylight in the ceiling, having a glazed surface of at least 3 sq. ft. and arranged so as to provide ventilating openings of at least 1½ sq. ft. to the outer air above the roof of the structure or into a court or yard of lawful dimensions, for one or two water closets or urinal fixtures and 1 sq. ft. additional for each additional water closet or urinal fixture.

(5.1.5.5) By some approved system of mechanical exhaust ventilation of sufficient capacity to exhaust at least 40 cu. ft. of air per min. per water closet and per urinal for public toilet rooms, and at least 25 cu. ft. per min. for private interior bathroom.

(5.1.5.6) Interior bathrooms and water closet compartments shall have openings from adjacent rooms or corridors ample to provide a sufficient inflow of air to make exhaust ventilation effective.

(5.1.5.7) The use of pipe shafts as ventilating shafts is forbidden and such pipe shafts shall be floored over solidly at every third floor. Separate exhaust flues shall be provided for every 250 ft. of height of structures, and these flues shall be of approved construction.

(5.1.6) Inside locker rooms and rooms of similar usage shall be provided with exhaust ventilation giving at least two changes of air per hour.

(5.1.7) Refrigerating plants shall be ventilated in accordance with the rules and regulations of the Fire Department.

(5.1.8) Inside spaces where cooking of any kind is done shall have a mechanical exhaust ventilation of at least 150 cu. ft. per min. The exhaust shall be collected in a sheet metal flue connected to an independent common flue in a fireproof shaft. Such flues shall be of No. 16, United States gage sheet steel, or terra cotta, and shall be connected to a separate fan.

(5.1.9) Spaces above grade, with or without windows, designed for human occupancy only, shall have ventilation either from windows or from mechanical means, or from both, in accordance with the following index and requirements:

Cubic contents per person plus 10 times floor area per person plus 100 times the entire window frame opening per person equals Index.

For Rooms with Windows

If the Index is less than 300 there shall be supplied an amount of fresh air equal to 2½ cu. ft. per min. per sq. ft. of floor area, and an air exhaust of 2 cu. ft. per min. per sq. ft. of floor area.

If the Index is between 300 and 520 there shall be supplied an amount of fresh air equal to 2 cu. ft. per min. per sq. ft. of floor area, and an air exhaust of 1½ cu. ft. per min. per sq. ft. of floor area.

If the Index is between 520 and 850 there shall be supplied an amount of fresh air equal to 1½ cu. ft. per min. per sq. ft. of floor area and an air exhaust of 1¼ cu. ft. per min. per sq. ft. of floor area.

If the Index is between 850 and 1650 there shall be required an air exhaust only of 1 cu. ft. per min. per sq. ft. of floor area.

If the Index is above 1650 no ventilation is required.

For Rooms without Windows

If the Index is below 850 the requirements shall be the same as for rooms with windows.

If the Index is between 850 and 1650 there shall be required an air supply of 1 cu. ft. per min. per sq. ft. of floor area and an air exhaust of 1 cu. ft. per min. per sq. ft. of floor area.

If the Index is over 1650 there shall be required an air supply of 1/3 cu. ft. per min. per sq. ft. of floor area and an air exhaust of 1/3 cu. ft. per min. per sq. ft. of floor area.

Interior partitions shall have transoms or equivalent openings, and when partitions occur 30 ft. or more away from a window or similar opening the room so formed shall have ventilation based upon the Index without windows.

(5.1.10) Spaces below grade with or without windows, designed for live storage of four or more gasoline propelled cars operated within the storage space under their own power, shall have at least four changes of air exhaust per hour by mechanical means, with provision for a corresponding air inflow from an uncontaminated source. Two changes of the four shall be taken from near the floor.

Spaces above grade with or without windows, designed for the same purpose, shall have openings near the floor on all outside and court walls. These openings shall be at least 6 in x 4 in. and within 6 in. above the floor, and shall be spaced between wall columns and at least every 16 ft. where columns do not occur. Such spaces shall also be subject to the requirements of (5.1.3).

Pits below floor levels shall have mechanical exhaust ventilation taken from near the bottom of the pits.

(5.1.11) Plans for structures (except one- and two-family dwellings) designed for human occupancy and filed with the Bureau shall have designated thereon the number of persons which the rooms and various spaces are planned to accommodate.

In article 11, heating appliances, combustion, and chimneys are considered separately.

The following ordinances are recommended for heating appliances.

Structures hereafter constructed shall be provided with ample means for heating, as required by the rules of the Board.

The design and installation of heating apparatus shall be as required by the rules of the Board.

The code recommends the adoption by the Board of the following rules regarding heating appliances.

(11.1.3) Heating plants shall be of capacity adequate to maintain the following minimum indoor temperatures with the outside temperature at zero degrees Fahrenheit:

60° F. in rooms for the display and sale of merchandise and similar occupancies.

65° F. in living quarters of multiple dwellings, offices, public spaces of auditoriums, theaters, assembly rooms and restaurants, and in similar occupancies.

(11.1.4) Pipes for Steam and Hot Water Heating

(11.1.4.1) Contact between steam or hot water pipes and any woodwork or other combustible material is forbidden.

Steam or hot water pipes shall have a minimum clearance from any combustible material of ½ in.

Where steam or hot water pipes are located within 1 in. of any combustible material, such material shall be protected by a metal casing or lining and where passing through stock shelving shall be covered with at least ½ in.

of insulating material. Steam and hot water pipe coverings shall be of fire retarding material.

(11.1.4.2) Only when amply protected against freezing may concealed hot water piping be located in an outer wall in any structure.

(11.1.4.3) Heating pipes shall be so installed as to provide safely for all expansion and contraction.

(11.1.5) Distributing pipes connected to warm-air furnaces shall be kept at least 1 in. away from any woodwork, and if less than 2 in. away, the woodwork shall be protected by sheet metal covering or other incombustible material.

(11.1.6) Furnaces and Boilers

(11.1.6.1) Furnaces or boilers having grate or burner areas of 3 sq. ft. or more shall be set upon masonry foundations, which shall rest upon incombustible construction or assemblies. Any such boiler operating at 15 lb. pressure or more shall be enclosed in a room whose walls have a fire resistive rating of at least 3 hr.

(11.1.6.2) Furnaces or boilers using solid or gas fuel having grate or burner areas less than 3 sq. ft. may be set on wood floors, provided they rest upon foundations consisting of at least 2 in. of solid brick and 4 in. of hollow tile, or the equivalent of these two materials, set on sheet metal plates at least as thick as No. 14 United States gage and at least 24 in. larger in all directions than the base of the boiler or furnace, if solid fuel is used, and 6 in. larger in all directions if gas fuel is used. The tile shall be laid with open ends in contact, when solid fuel is used an ash plate or ash pan of metal at least as thick as No. 10 United States gage shall be provided above the foundation.

(11.1.6.3) Boilers with water-cooled bases having grate areas of 3 sq. ft. or less may rest directly on sheet metal bases without any intervening masonry, provided the sheet metal is at least as thick as No. 14 United States gage.

(11.1.6.4) Combustible material shall be at least 6 ft. away from the front, 4 ft. away from the top and 3 ft. away from the sides of furnaces or boilers, including enclosures. These separations may be reduced one-half when at least 1½ in. of asbestos insulating material or its equivalent is applied to the furnace or combustible material.

In rooms where fuel oil-burning equipment is installed the ceiling shall be insulated with material or assemblies having a fire resistive rating of at least 1 hr. and extending 4 ft. on all sides and 8 ft. in front of the furnace. If the ceiling is constructed throughout so as to have a fire resistive rating of at least 1 hr. the insulation may be omitted.

(11.1.6.5) Every furnace or boiler shall be connected to a regulation chimney.

(11.1.7) Rooms in which boilers or furnaces are located shall have adequate means for fresh air supply to insure proper combustion. Direct connection of air inlets to the ash pits or combustion chambers of boilers or furnaces is forbidden.

(11.1.8) Cooking, laundry and heating stoves and combination coal and gas ranges installed in dwellings shall be set on hearths supported by masonry trimmer arches extending at least 6 in. on all sides beyond such appliances (except that such appliances, when supported on legs furnishing an open air space of at least 4 in. below the bottom of the appliance, may be set on sheet metal of at least No. 24 United States gage, or other approved incombustible material).

The placing of such appliances within 24 in. of wood stud partitions, wood furred walls or combustible material is forbidden unless they are protected by a shield of metal or other approved incombustible material so attached as to preserve an open air space behind it and to extend from the floor to 1 ft. above and 12 in. beyond the sides of such appliances, in which case the appliance shall be placed at least 6 in. away from a wood stud partition, wood furred wall or combustible material.

Domestic gas ranges in which the clearance between the base frame and the floor is 2 in. or less shall be set on a base of hollow clay tile 4 in. thick or its equivalent, extending at least 2 in. beyond the range on all sides. When such clearance is more than 2 in. but less than 6, such ranges shall be set on a base of asbestos board 3/16 in. thick held between 2 sheets of metal at least No. 24 United States gage and extending at least 2 in. beyond the range on all sides. When such clearance is more than 6 in. or the lower burners of the range are 12 in. or more above the floor measured from the burner ports, no protection shall be required. When such ranges are set so that the oven back or side of the cooking top is less than 6 in. from combustible material, the combustible material shall be protected by asbestos board 3/16 in. in thickness and by sheet metal of at least No. 24 United States gage.

Stoves and ranges using solid fuel shall be connected by a smoke pipe to a regulation chimney.

(11.1.9) Exhaust Vents on Gas Appliances

(11.1.9.1) Gas appliances shall be connected to flues or outlet pipes as follows:

Every appliance used for domestic purposes using in excess of 50,000 B.t.u. per hr. (except in the case of the domestic gas range);

Automatically controlled appliances using more than 5000 B.t.u. per hr.;

Automatically controlled appliances using less than 5000 B.t.u. per hr., which are not equipped with an effective device to shut off the gas supply to the main burner or burners automatically when the constantly burning flame or pilot flame is extinguished;

Appliances installed in the same room which, in the aggregate, use, at normal rating 30 B.t.u. or more per hr. for each cu. ft. of room space;

Water heaters installed in bathrooms, bedrooms, or in any place not adequately ventilated.

(11.1.9.2) Gas appliances having vent outlets, but not requiring connection with flues or outlet pipes, may be left unvented; but if vented, they shall be connected to flues conforming to the requirements of this Article, or to outlet pipes.

(11.1.9.3) Flues and outlet pipes to which gas appliances are connected shall have cross-sectional areas at least equal to the aggregate areas of the vent outlets of the appliances connected to them, but in any case the least internal dimension or diameter shall be 3 in.

Flues and outlet pipes for the venting of gas appliances shall be carried to and through the roof or through an exterior wall to the outer air. In all cases outlet pipes shall be surmounted by a suitable cap.

Flues shall be constructed as required for low temperature chimneys in (11.3.8.1.).

Outlet pipes shall be standard water, steam or soil pipe, clay pipe or other approved incombustible, corrosion-resisting material so connected as to prevent leakage at the joints.

Outlet pipes shall be so installed that there is a clearance on all sides of at least 3 in. between such pipe and woodwork or other combustible material. The extension of such outlet pipes through a floor is forbidden.

(11.1.9.4) Gas appliances shall be installed in conformity with the "Requirements for House Piping and Appliance Installation" of the American Gas Association, June 15, 1928 (except as otherwise specifically provided in this Code).

(11.1.9.5) Automatically controlled gas appliances which connect to flues of other heat producing devices shall be equipped with an effective device to shut off the gas supply to the main burner or burners automatically, when the constantly burning flame or pilot is extinguished. The connection of such *gas* appliance to the flue shall be at least 9 in. above the connection of the other heat producing appliance.

The second part of Article 11 covers combustion and combustion appliances. The recommended ordinance is of one sentence and simply makes combusion appliances subject to the rules of the Board, but excepts from the rules "furnaces rated to burn 15 lb. or less of anthracite per sq. ft. of grate surface per hr."

Among the rules suggested for adoption by the Board to make this section effective are (1) forbidding the discharge of annoying or injurious quantities of solids into the air from appliances subject to the code provisions; (2) requiring the use of ash and soot collectors so designed as to keep fly-ash or cinders from coal-burning plants to a maximum of 400 grains per 1000 cu. ft., and prohibiting visible soot or smoke where oil

is the fuel; (3) specifying the tests to be used in determining the amounts of solids discharged; (4) specifying details of construction of the combustion chambers of refuse incinerators, which specifications are entirely devoted to reducing the fire hazard from these appliances.

The third part of Article 11, dealing with chimneys, proposes a brief ordinance placing all chimneys under the rules adopted by the Board and followed by a set of proposed rules which are exhaustive on the aspects having to do with fire protection. Chimneys are arbitrarily divided into three classes, viz: Low temperature, medium temperature, and high temperature with the limiting entering temperatures of the gases placed at 600°, 1200°, and above 1200° F., respectively. Construction details for each class of chimney are then specified covering masonry, brick, and metal chimney constructions. Rules are also proposed to govern the construction and installation of warm-air ducts which also lean strongly toward specifying methods which are deemed safe against fire.

Comments on the Ventilation Provisions

In his speech when delivering the code, the representative of the Merchants Association stated that the question of ventilation was one of the most difficult with which to deal.

As the ordinance sections merely make the matter subject to the rules of the Board, the interesting features are the recommended rules.

The first point is the provision regarding below-grade spaces and toilets. Below-grade spaces must use mechanical means and the minimum quantity is specified. Toilets must be ventilated, but the proposal would permit the use of almost any means available for doing so, except that pipe shafts may not be used as the exhaust shafts.

The most interesting feature of the whole section on ventilation is the method of calculation set up for determining the ventilation requirements of "spaces above grade, with or without windows, designed for human occupancy only." The phrase "designed for human occupancy only" is rather ambiguous, but presumably this would mean dwelling quarters primarily, and might be construed to include working quarters which do not fall under the provisions of (5.1.5). If so interpreted this rule would apply to the great majority of building space. The proposal is that either window or mechanical means of ventilation may be used as determined by the Index. The index number itself is easily and simply determined for any given room by the rule of (5.1.9).

For rooms with windows, it is interesting to test the application of the rule by a simple example:

Consider the case of a small office with small window area. This would be an extreme case. Assume a room 10 ft. x 12 ft. x 12 ft. ceiling, with 4 people and with one window opening of 3 ft. x 6 ft. The Index would be

$$\frac{(10 \times 12 \times 12)}{4} + \frac{10\,(10 \times 12)}{4} + \frac{100\,(6 \times 3)}{4}$$

$$= 380 + 300 + 450 = 1130$$

This falls between 850 and 1650 and by the rule would require the exhaust of 1 cu. ft. per min. per sq. ft. of floor area, or 120 c.f.m. This would call for the use of an exhaust fan mechanically driven if the rule is rigidly interpreted. In view of the fact that the example was rather extreme this does not seem an unreasonable requirement.

The example permits easy examination of the nature of the rule. The numerical value of the index is affected by room volume per person and by room area per person. Both of these are indexes of crowding. For fixed room dimensions they can be increased in numerical value only by decreasing the occupancy. The third factor is an index of the natural air circulation possible from outside. For fixed dimensions it can be decreased only by decreasing occupancy. The index for a given room with given window dimensions thus depends for its value entirely upon room occupancy. As occupancy decreases the numerical value of the index increases and the ventilation requirements of the rule decrease.

For a fixed occupancy and room dimensions the value of the index can be increased by increasing the window openings. Thus in the example just given, if two windows of 3½ ft. x 6½ ft. were present the value of the index would become 1820. This makes it unnecessary to use mechanical ventilation. It will be noted that in this case the area of window opening would be less than half the normal area of one outside wall of the room. In other words, mechanical ventilation will not be required in rooms having reasonable amounts of window openings unless the crowding of occupants becomes excessive. Under this rule a room in a dwelling house, hotel or apartment room would not require mechanical ventilation so long as it has windows.

Rooms without windows would require mechanical supply and exhaust in all cases.

Analysis of the actual working of the ventilation rules as now drawn is difficult because of the great variety of cases which can arise. On the whole it seems that the index numbers as now fixed may be expected to work out within reasonable limits and the form of the code makes it possible to amend the fixing of the index numbers if in use it is found that the limits are unsuitably located. So far as known the use of these index numbers is new and the idea seems to deserve a trial because of its simplicity of application.

The section having to do with heating apparatus contains no novel features. It does lean heavily toward fire prevention. In this respect it resembles a marked tendency observable in so many recent codes. In some instances these provisions seem ridiculously finely drawn. For instance, the code proposes that the distribution pipes from warm-air furnaces shall be kept at least 1 in. away from woodwork and if less than 2 in. the woodwork must be covered. If strictly enforced such a provision often results in excessive expense. On the other hand, a fire is a serious menace in the crowded districts and much is to be said in favor of the increasing attention being given to fire prevention measures in building codes.

On the whole it is difficult to see how the proposed code can be looked on as anything but a well done piece of work. It still has to be enacted into law, and its success in operation remains to be seen.

Abstracts . . .

Reviews and Summaries of . . . . Current Papers, Books and Pamphlets

House Insulation—Its Economies and Application

Printed by the Government Printing Office and obtainable through the Superintendent of Documents; 10 cents. It is confusing to attempt to determine the real responsibility for this pamphlet. On the cover it bears the words "United States Department of Commerce" and also "National Committee on Wood Utilization." The title page carries the information that it is the report of a sub-committee of the National Committee on Wood Utilization. It is easily distinguished from most governmental bulletins because its cover is modernistic in character. Paper covered; 6 in. x 9 in.; 52 pages; well illustrated.

In the foreword the director of the National Committee on Wood Utilization states that the main object of the booklet is to point out to homebuilders and homeowners the economics and advantages involved in the proper use of insulating materials for home construction.

The subject matter proper, which is credited to Russell E. Backstrom, is divided into nine principal sub-divisions, and an appendix of four parts. The nine principal divisions are: History and Uses; Why Insulate?; Types of Insulation; General Considerations; Insulation of Walls, Floors, and Roofs; Thickness of Insulation to Use; Methods of Applying Insulating Materials; Insulation for the House Already Built; Cost of Insulating.

The author feels that economy and comfort are the two particular reasons for insulation in a home. In considering economy, figures varying from 20% to 40% are quoted as being the fuel saving realizable from the use of insulation. Close examination of the sources from which these figures are taken, however, and a careful consideration of the methods of calculation used, make it perfectly evident that these figures are purely estimated savings. The pamphlet quotes no examples of fuel savings actually accomplished.

The same method of classification usually followed with insulating materials is used, and the sections on methods of application give detailed installation instructions.

Under "Cost of Insulating" a number of tables are included which give estimated costs when using insulating material in small houses. One of these tables is appended here.

A fairly complete bibliography is included in the booklet as Appendix D.

APPROXIMATE APPLIED COST OF RIGID, SEMI-RIGID, AND FLEXIBLE INSULATION WHEN ADDED TO ORDINARY FRAME OR MASONRY CONSTRUCTION[1]

Cost of insulating material per 1,000 square feet	Material and labor cost when insulating material is placed between framing members.			Material and labor cost when insulating material is placed over the edges of framing members or furring strips		
	Per 1,000 sq. ft. of net area	For a 5-room bungalow	For a 6-room, 2-story house	Per 1,000 sq. ft. of net area	For a 5-room bungalow	For a 6-room, 2-story house
Insulation ½ in. thick:						
$40	$66.50	$120.00	$166.50	$61.60	$111.00	$154.00
$45	72.25	130.00	181.00	67.10	121.00	167.50
$50	78.00	141.50	195.00	72.60	131.00	181.50
$55	83.75	151.00	210.00	78.10	140.50	195.00
Insulation 1 in. thick:						
$75	106.75	192.00	267.00	100.10	180.00	250.00
$80	112.50	202.50	281.00	105.60	190.00	265.00
$85	118.25	212.50	296.00	111.10	200.00	278.00
$90	124.00	223.00	310.00	116.60	210.00	292.00

[1]It should be noted that these figures are applicable only when the insulation is added to ordinary construction. If the insulating material replaces some other building product, the net cost is the difference between the total material and labor cost of the product used and the total cost of that replaced.

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American Society of Heating and Ventilating Engineers Guide

Tenth edition of this annual volume; new cover design; contains 876 pages besides a list of members; illustrated; 6 in. x 9 in.; obtainable through "Heating and Ventilating"; price $5.

The 1932 edition follows the practice of former years in that it is divided into four major sections, viz: text section, catalog data section, index, and list of members. The foreword states that the significant additions and revisions which make this edition distinctive are an increased number of chapters, the inclusion of over fifty per cent new subject matter, and the rewriting of nearly every chapter. Further, it states that "a new grouping of subjects has been made and more extensive cross-indexing will assist the user in locating needed specific information." As expanded and rearranged, 40 chapters are now included in the text section.

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The Physics of High Pressure

By P. W. Bridgman, Ph.D.

Illustrated; cloth bound; 5½ in. x 8¾ in.; 398 pages. Published by The Macmillan Company, New York, 1931; price $5.50.

The book is a summary, and to some extent a description, of the personal work of the author in the field of high pressure physics wherein his work has been of outstanding excellence. Being in close touch with all phases of his subject, his comments and his summaries of the work of others are as valuable to the casual reader as are his descriptions of his own efforts. They have the effect of putting the reader in touch with developments without long descriptions of apparatus details and results.

As might be expected, the author throughout is the

physicist interested in the general laws and in reducing his experimental findings to orderly conclusions. He is not an applier and neither attempts to apply nor to describe applications. As a result, the engineer will find but little of immediate usefulness in the book. Rather it is one of those books which causes the engineer and technical worker to realize how rapidly the laboratory phases of such subjects develop.

Heating engineers may be interested to note that the author, in a historical chapter, refers to the early problem of the study of the compressibility of water. The Englishman Perkins is mentioned as one of the early experimenters in this field. Perkins' applications of high pressures to hot water heating, and his ingenious and enthusiastic use of hot water at high pressures, are well known. Probably most of us do not realize that he also attempted measurements to learn some of the physical properties of water under pressure.

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Heat Transmission as Influenced by Heat Capacity and Solar Radiation

By F. C. Houghten, J. L. Blackshaw E. M. Pugh, and Paul McDermott

A.S.H.V.E. paper, annual meeting, Cleveland, January, 1932. Approximately 12,000 words, seven tables, three photographs of testing apparatus, 36 curves and sketches principally showing test results, a bibliography of six titles.

Results of a study of the flow of heat through eight roof panels which were exposed to solar radiation on the one side, and to a steadily maintained temperature of approximately 70° on the other. The flow of heat through the panels was thus the result of the influence of the sun's radiant heat as it reached such panels when exposed horizontally on building roofs. Data were obtained showing the outside surface temperature, inside surface temperature, quantity of heat entering the outside surface, and quantity of heat entering the building from the inner surface during summer days. The data were taken at close enough intervals and for long enough periods to permit plotting the heat quantities against time, and to show graphically the periodic nature of the flow, the way the heat received at the outer surface diminishes as it flows inward, and the time lag between the crests of the waves of heat flow. As the tests included some days of almost complete sunshine, maximum quantities of flow were at least approximated for Pittsburgh.

Apparatus used during the tests is described in some detail. Briefly, an insulated box was placed on the roof of a building where the sun could strike at all hours. The top of this box consisted of the panels being tested, which panels were carefully built up to secure the desired characteristics. The temperature inside the box was carefully controlled. Heat flow measurements through the test panels were made by the use of heat meters, one being placed on the top surface and one on the bottom surface. Temperature measurements were by thermocouples. A pyrheliometer was placed near the box and measured the sun heat received on its specially prepared surface.

The paper contains a brief discussion of the heat quantities involved when solar radiation is received on a surface and causes heat to flow through the material and out into air on the opposite side.

Test panels were made up of the following:

(a) 2 in. laminated iron and cork
(b) 4 in. laminated iron and cork
(c) 8 in. laminated iron and cork
(d) 2 in. pine
(e) 6 in. concrete
(f) 4 in. gypsum
(g) 4 in. cork and concrete

Physical properties of these panels were carefully determined, and are tabulated in the paper.

Results of the tests as included in the paper are presented almost entirely in graphical form.

In order to make use of data of this kind it is desirable that a simple method of calculating the heat flow from the inner surface under known conditions on the outside be developed. The paper points out that such a problem contains many variables and that only a partial solution is attempted in the paper. In attempting to find a solution, the authors analyze the problem mathematically and outline a solution involving considerable computation. This method was applied to several of the tests and was found to produce results which would indicate that it was satisfactory for most of the panels tested. The method is laborious, however, and a second and shorter method of analysis is outlined which eliminates some of the steps in the longer method. Both methods are involved and neither seems adaptable for use.

The paper also discusses and explains the present condition of the project, outlines gaps in the information now available, and mentions important factors which will stand further investigaton.

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Temperatures of Different Surfaces Under the Influence of Solar Radiation in the Daytime and Backradiation at Night

From "Die Temperaturen technischer Oberfluchen unter dem Einfluss der Sonnebestrahlung und der nachtlichen Ausstrahlung," by Karl Schropp; Gesundheits-Ingenieur, Berlin, No. 50, December 12, 1931; approximately 12,000 words.

ABSTRACTED BY A. A. BERESTNEFF

The relation between solar radiation and the temperatures of different kinds of surfaces exposed to this radiation is not yet fully investigated, and data on this subject are not sufficient. In this article, the results of numerous investigations made on this subject are published in systematized form. Emphasis is also given to the importance of the results for solving some technical problems, especially in heating and refrigeration.

During the period of these investigations (1927-1930) the surface temperatures of different materials exposed to perpendicular solar radiation were measured at different seasons. The materials, in form of a thin plate, were located on a 2 in. thick cork plate. Such an arrangement corresponds to the heat insulation of a well-insulated roof.

At the time of solar radiation during the day hours with still air, the increase of surface temperature above the outside air temperature was: for black surface, 81°-99° F.; for aluminum sheet (rough), 54°-63° F.; for white surface, 27°-36° F.; for glossy aluminum foil, 27° F.

The temperature decrease for white and black surfaces during the night hours (clear air, cloudless sky) due to backradiation from the surfaces into the surrounding spaces was between 3.6° and 7.2° F. For glossy aluminum foil the surface temperature was nearly the same as the temperature of the air.

It is interesting to note that these results indicate a peculiar phenomenon:

During the daytime the absorption of the solar radiation by the white and black surfaces is very different. During the night, however, both the white and black surfaces behave almost alike. During the night, heat is being emitted from the surfaces and *for the same length of radiation waves* the emission should be proportional to the absorbing capacity of the materials. The fact that the surfaces did not emit heat proportional to their absorbing capacity is explained by noting that the intensity of both kinds of radiation—emission and absorption—for any material depends upon the length of the radiation waves. At the temperature of the sun, which is about 10,800° F. absolute, the length of waves is very small (0.48 m, where $m = 0.001$ mm). For such short waves, there is a very great difference between the white and black surfaces, the white surface under these conditions being a much poorer absorber and emitter of radiant heat than the black one. For backradiation during the night, the temperature of radiating surface (either black or white) is much less than the temperature of sun, being only, say, 510° F. absolute (50° F.). For such low temperatures, the length of radiation waves is about 10 m and at this length of waves there is almost no difference between black and white color regarding the heat radiation.*

From the above it is obvious how important it is to choose a proper kind of surface for commercial purposes, because this may result in great economy in cooling energy during summer days, and in heating energy (although to a much less extent) during winter nights.**

During the investigations, the amount of heat absorbed from solar radiation by different surfaces was also measured. For white surfaces, this amount was found to be as high as 81.2 to 100 B.t.u. per hr. per sq. ft., and for black surfaces from 218 to 240 B.t.u. per hr. per sq. ft. These figures are for clear days and perpendicular sun rays.

Other articles on this subject are:
1. E. Schmidt, "Insulation by Aluminum Foils," *V.D.I., Zeitschrift*, 1927, page 1395.
2. E. Reisch and K. Schropp, "The Thermoelectrical Temperatures and Measurement of Heat Flow," *Mitteilungen aus dem Forschungsheim fur Warmeschutz*, e.V., Munchen, Part 8, 1930.
3. H. Kohen, "The Problems of Radiations, *V.D.I., Zeitschrift*, 1931, page 1033.
4. E. Schmidt, "Heat Radiation by Different Surfaces at Usual Temperatures," *Gesundheits-Ingenieur*, Sp. No. 20, 1927.

*This phenomenon is interesting in connection with so-called radiant or panel heating.—*A.A.B.*

**It may be of particular interest for such parts of this country as California.—*A.A.B.*

Humidity of Air in Heated Rooms

From "Die Luftfeuchtigkeit beheizter Raume," by Richard Flugge; Gesundheits-Ingenieur, Berlin, No. 15, April 11, 1931; approximately 1600 words.

ABSTRACTED BY A. A. BERESTNEFF

The conclusions drawn in this article are based on investigations carried on by the author in 1929. The results of these investigations showed that, as a rule, there is a considerable difference in relative humidity of air inside the rooms heated by hot water and by low pressure steam heating systems, namely, the relative humidity in the latter case was found by the writer to be about 10% lower than in the former case.

All other conditions being more or less the same for both systems, the explanation given by the writer for this phenomenon is as follows:

A material difference between the steam and hot water heating systems—when applying usual radiators in both cases—lies in the surface temperature of the radiators which, in the case of steam, is considerably higher than in the case of hot water. For the tests discussed, the surface temperature of the hot water radiators was about 160° F. The much higher temperature of the surface of the steam radiators causes slow burning (scorching) of dust particles in the surrounding air. This in turn causes an appearance of special gases (Schweigase) which absorb moisture from the air.

The author considers also an article written by Dr. H. Habs on the same subject. In the opinion of Dr. Habs, the results of measurements found by R. Flugge as to the difference in relative humidity may be due not to the different kinds of heating systems, but to a different character of heating, namely, whether it was continuous or intermittent. Opposing this opinion, Flugge emphasizes the fact that the steam heating system, during the time of his investigations, was operated continuously, while the hot water heating system was operated intermittently and that, nevertheless, the relative humidity of air measured in the former case was smaller than in the latter, which evidence contradicts the opinion of Doctor Habs and proves the statement made by R. Flugge. This fact may account partly for what we hear sometimes from people claiming that steam heating causes the air to be dryer than does the hot water system.

Other articles on this subject are:
1. R. Flugge, *Gesundheits-Ingenieur*, page 315, 1929.
2. Doctor Habs, *Gesundheits-Ingenieur*, No. 39, 1930.
3. R. Flugge, *Die Feuchtigkeit in Hochbau*, C. Marold, Halle.

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Investigations on Heat Insulating Capacity of New Wall Constructions

From "Warmeschutztechnische Untersuchungen an neueren Wandkonstruktionen," by Dr.-Ing. I. S. Cammerer; Gesundheits-Ingenieur, Berlin, No. 43, October 24, 1931; approximately 7000 words.

ABSTRACTED BY A. A. BERESTNEFF

The article summarizes the results of investigations and conclusions made by the writer on behalf of the German State Research-Society for Economy in Building-Maintenance. The purpose of these investigations

was (1) determination of moisture content inside the different materials of existing buildings; (2) measurement of the heat insulating capacities of different types of constructions, and (3) establishment of a relation between the coefficient of heat conductivity and humidity content of different materials.

According to the writer, the accuracy of measurements was within ± 10%, which was possible because of special conditions created during the period of investigations (1929-31) in regard to the inside conditions of the buildings under study.

Humidity content seems to be a function of several factors, the most important of which are: (1) wall thickness, (2) height of the wall where the sample is taken, (3) age of building, (4) exposition, and (5) kind of room. Of these, the items (2), (3), and (4) are of no great influence, while items (1) and (5) are important.

Concerning item (5), it is obvious that the conditions inside the rooms of buildings, namely, the temperature and relative humidity, may materially influence the depth of penetration and the accumulation of moisture.*

Table 1 contains some figures taken from Table 1 of the abstracted article:

TABLE 1

Item	Construction	Total thickness of wall, in.	Kind of room	Moisture content by Vol.—% Main material	Mortar	Inside finish	Outside finish
6	7.3 in. solid bimsbetonwall (pumic concrete).	8.5	apartment room	19.5	—	2.4	—
8	7.9 in. solid bimsbeton plates plates (pumic concrete).	9.05	unheated room	24.0	—	—	—
13	2 in. slag concrete 4 in. air space 2.35 in. bimsbeton (pumic concrete).	—	heated room	10.1	—	—	—
16	11.2 in. slag concrete hollow blocks, 0.2 in. groove packing plate.	—	heated room	4.0	—	1.5	6.8

The writer does not give the outside conditions. However, in most cases of his investigations the outside conditions are the same since the investigations were made on buildings located in the same localities.

To measure the moisture content, samples from corresponding parts of buildings were taken. The reason why the measuring was limited by the walls was the difficulty of taking samples from other parts of the buildings without spoiling them. In the article, two other tables are given which include the results of measurements made before Doctor Cammerer by H. Reicher and C. Hofbauer. The data of these tables are like those given in Table 1, thus proving in general the correctness of measurements made by Doctor Cammerer.

The writer also gives a special diagram which shows a difference between different kinds of wall materials as to the moisture content remaining continuously in these materials. This diagram is given as Fig. 1 and needs no further explanation.

*Compare data as found by Doctor Cammerer in the article by A. A. Berestneff, page 27.

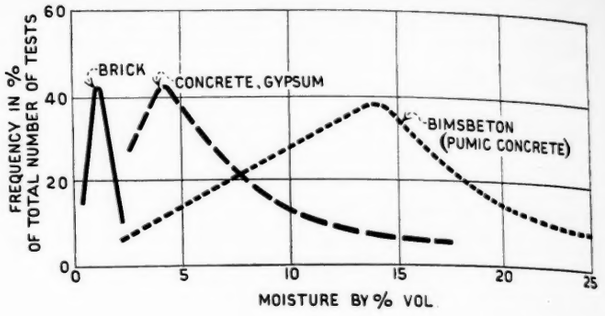


Fig. 1

In addition to the data tabulated in Table 1, the writer gives the insulating capacity of all the walls mentioned in the table. The calculation of the corresponding heat transmission coefficients is based on the measuring of the actual heat losses through the parts of the constructions. To compare the results, the writer expresses all insulating capacities in terms of equivalent thickness of brick wall. Omitting the details of these calculations, we want to emphasize the results found by Doctor Cammerer, viz.: In almost all cases the measured insulating capacities of the structure parts mentioned in the above table average 50%, and more, smaller than the full insulating capacities required at the time of maximum load in these localities. Sometimes the insulating capacity is as low as 43% to 42%.

Taking in account that conductivity is a function of the specific weight and moisture content, the writer concludes that it is quite possible to determine with sufficient accuracy the heat conductivity of a material so far as its conductivity for a certain specific weight and at zero moisture, as well as its specific weight and moisture content under the existing conditions are known. For a given specific weight, the conductivity is influenced by moisture content to a very great extent. The writer illustrates this relation by the following table:

Moisture content by Volume—%	Increase of coefficient of conductivity of a dry material for 1% volume increase of moisture content		
	For brick wall as found by Cammerer	For brick wall as found by Schmidt	Average value for any material as found by Cammerer
(1)	(2)	(3)	(4)
2	24.8	25.5	25.0
5	16.2	16.6	15.0
10	10.2	10.8	10.8
20	6.1	6.8	6.8

Columns (2) and (3) show that the results found by Doctor Cammerer coincide very well with those found by Schmidt. At the end of the article a special table is given where the values of correction coefficients for determination of heat conductivity of materials for different moisture content are tabulated:

Moisture content by % volume	1	2.5	5	10	15	20	25
Increase of conductivity as compared to a dry material in %.	30	55	75	108	132	155	175

Other articles on this subject are:

1. I. S. Cammerer, *Gesundheits-Ingenieur*, June, 1930.
2. C. Hofbauer, *Sparwirtschaft*, No. 11, 1930.
3. I. S. Cammerer, *Zeitschrift f. d. ges Kalte Industrie*, No. 10, October, 1931.

News of the Month

Oil Burner Show Scheduled for April 11-16

Plans for the largest show in the history of the oil burner industry are revealed in an announcement of the program for the ninth annual convention and show of the American Oil Burner Association, to be held in Mechanics' Hall, Boston, Mass., April 11-16. A full week's activity includes one engineering and two merchandising sessions, in addition to regularly scheduled meetings for manufacturer members and members of the dealer division. Entertainment features have also been scheduled, and a record attendance is expected.

Among the addresses to be delivered at the engineering session, held on Thursday, April 14, are: "Air Conditioning," by Esten Bolling, consulting engineer; "How Oil Burner Dealers Can Profitably Merchandise Heating Specialties," by R. G. Bookhout, and a "Technical Research Report," by Prof. L. E. Seeley, Sheffield Scientific School, Yale University.

At the merchandising sessions, to be held Wednesday, April 13, and Friday, April 15, the following topics will be discussed: "The Commercial and Industrial Market," by B. K. Breed; "Sales Planning and Advertising," by Robert Tinsman; "Selling Women on Heating and Cooking with Oil Fuel," by Katharine A. Fisher, director, Good Housekeeping Institute, and "The Place of the Distillate Burner in the Industry," by R. M. Sherman.

Manufacturers Will Not Exhibit at A. G. A. Convention

At a special general meeting of the manufacturers' section, American Gas Association, held in Chicago, February 18, Philip O. Deitsch, manager of group activities, reported that individual expressions of manufacturers indicated they desired to abandon the idea of an exhibition of appliances in connection with the 1932 convention of the American Gas Association, to be held in Atlantic City, October 10-14. The position of the manufacturers had been affirmed at a meeting of the managing committee of the manufacturers' section, held January 12.

Two resolutions, recommending that the position of the managing committee be reaffirmed, and that cooperation of the Atlantic City Hotel Association in preventing individual exhibitions of gas appliances in hotel rooms be solicited, were proposed and carried at the Chicago meeting.

As HEATING AND VENTILATING goes to press, no decision has been reached as to whether or not the convention will be abandoned altogether.

A. G. A. Committee to Study Conversion Rental Plans

In its information service bulletin, issued March 1, the manufacturers' section of the American Gas Association reports the progress of the activities of the committee on house-heating. Efforts are being concentrated on the commercial aspect of supplying heating and air conditioning by gas.

One of the activities of the committee will be keeping the industry advised of current sales plans and policies in this line. Compilation of the sales plans and policies of a number of outstandingly successful companies, and an individual presentation of each, is scheduled for 1932. A study of the rental plan of sales for house-heating equipment will also be made, covering the sales policies employed, results obtained, and a discussion of dealer relations in connection with rental plans. Comparisons will be drawn between rental plans, and long term payment sales, from data compiled by companies having experience in both forms of merchandising.

An investigation of air conditioning equipment, economics, and future development is being made, and the program also includes study of temperature control from the standpoints of manufacturing aspects, a field study of current needs, developments in the distribution and sale of equipment, and installation and servicing practice.

Elizabeth Clark, feature-writer, "New York World-Telegram," whose series of six articles in the women's section of that paper on smoke abatement has aroused widespread interest in the subject among women in Greater New York.

New York Wages War on Smoke

An intensive campaign against smoke was conducted in New York during the week of March 14-19. Notable among the features of the campaign were newspaper articles and radio talks. The latter were made by Prof. H. H. Sheldon, professor of physics, New York University; Dr. Thomas Darlington, head of the smoke abatement committee of the Health Department, and Col. Elliott H. Whitlock, research professor, department of mechanical engineering, Stevens Institute of Technology.

The *New York World-Telegram* published a series of six articles by Miss Elizabeth Clark on its women's page in an attempt to obtain the cooperation of housewives in securing relief from the city's smoke. Written in popular style, the articles contained an unusual amount of technical and statistical data in regard to the harm and danger resulting in various diseases caused by smoke; the monetary loss resulting from dead plants, soiled clothes and

decorations, etc. In addition, this newspaper published an editorial on "Banishing Smoke," calling attention to the value of stokers in reducing smoke.

Eastern Supply Men Condemn Direct Selling

Among the resolutions adopted by the Eastern Supply Association at its spring meeting, held in New York, March 9-10, was one designed to combat the competition of direct-to-consumer selling organizations. The resolution was recommended to the industry by the officers and directors of the National Association of Master Plumbers, and provided for the reduction of profit margin on a limited number of staple fixtures, advertising in the public press, display of these fixtures in the contractor's place of business, with all goods distinctly marked with prices, and placing price tags on fixtures in the wholesalers' and manufacturers' showrooms, consistent with present day merchandising principles.

Other resolutions condemned the sale of their products by manufacturers to concerns other than wholesalers of plumbing and heating supplies, and called upon manufacturers to discontinue indiscriminate sale of products to wholesalers and selling organizations without regard to their financial responsibility. Maintenance of warehouses by manufacturers was also held to be detrimental to the industry.

A trade relations committee was established to carry out a program for the benefit of the plumbing and heating industries. The committee will endeavor to promote contacts and understanding between the manufacturers and wholesalers of the various districts.

New York Steam is 50 Years Old

The New York Steam Corporation celebrated its fiftieth anniversary March 3, the company having supplied its first customer March 3, 1882.

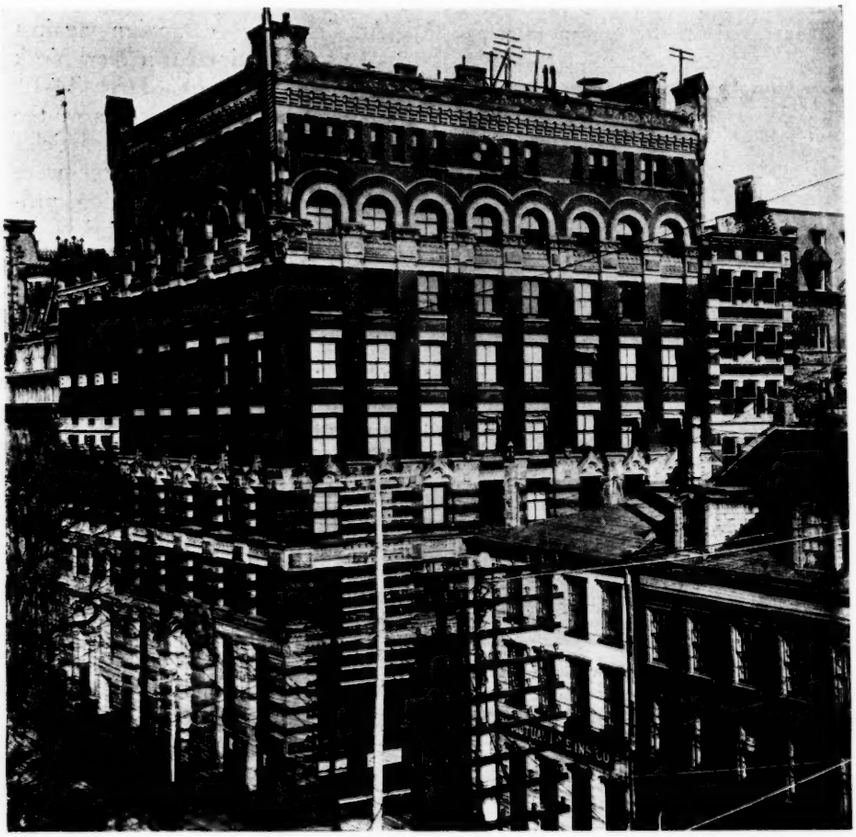
The first building served by district steam in New York was the building on the northeast corner of Broadway and Wall Street, owned by the First National Bank of the City of New York. Upon completion of the First National's new home on the same site, the New York Steam Corporation will resume the previously uninterrupted service.

The company reported for 1931 gross earnings of $9,731,843. The quantity billed to consumers during the year totaled 10,146,438,000 lb., compared with 9,984,873,000 lb. in 1930, although less coal was consumed in the generating stations in 1931.

During 1931, the corporation entered into contracts representing annual revenue of $1,419,582. Buildings served by the corporation or under contract, as of December 31, 1931, aggregated 2,179,903,000 cu. ft.

Office Cooling Discussed by Michigan Chapter

Field Studies of Office Building Cooling was the subject of an illustrated lecture presented by S. S. Sanford, Detroit Edison Company, to about fifty members and guests present at the meeting of the Michigan chapter, A.S.H.V.E., held Feb-



(Left) The first building in New York served by district steam—The First National Bank of the City of New York, on the N. E. corner of Broadway and Wall Street, to which district steam was supplied 50 years ago. (Below) Charles Edward Emery, the first chief engineer of the New York Steam Corporation, appointed 1879. Mr. Emery had a wide experience in marine, steam, hydraulic, electrical and patent engineering.

ruary 15, at the Detroit Engineering Society Building.

Mr. Sanford discussed the air conditioning of the first sixteen floors, and two basements, of the Union Guardian Building, and a brief sketch of the operation of the building was given by Mr. Wells, of the Union Guardian Building. Plans for air conditioning to be installed by the Detroit Edison Company during the coming year were also presented.

Heating Board Now Heating and Plumbing Board of Trade

Announcement has been made that the Heating Board of Trade of New York, Inc., organized in 1930 to improve existing commercial practices among contractors, engineers, manufacturers, jobbers, and utilities engaged in the heating business, has opened its membership to the plumbing industry and changed its name to the Heating and Plumbing Board of Trade of New York, Inc.

The board is located at 101 Park Ave., New York. William E. Taylor is secretary.

Concealed Radiation Discussed at Toronto Meeting

Concealed Radiation was the subject of an address made by Prof. E. A. Allcut, of the University of Toronto, at the joint dinner meeting of the Ontario section of the A.S.H.V.E. and the American Society of Mechanical Engineers, held February 1.

Fuel Consumption Continued Low in February

Mild weather during the month of February has resulted in a continuance of the reduced demands for fuel for heating purposes, during the season from September 1 to February 29. The accompanying table shows the amount by which the number of degree days fell below the normal in five cities, up to the end of February, and also the decrease expressed in per cent of the normal. Since the number of degree days is an index of fuel consumption, oil, coal and gas sales for heating are from 20% to 31.6% below normal.

DEGREE DAYS—SEPTEMBER TO FEBRUARY—FIVE CITIES

	Degree Days September 1 to February 29 this season	Degree Days September 1 to February 28 normal year	Per Cent this year below normal
New York	2889	3870	25.4
Boston	3457	4322	20.0
Pittsburgh	2953	3947	25.2
Chicago	3386	4609	26.6
St. Louis	2479	3652	31.6

H. & P. C. N. A. To Study Air Conditioning at Convention

Air conditioning will receive considerable attention at the forty-third annual convention of the Heating and Piping Contractors National Association, to be held at the Book-Cadillac Hotel, Detroit, Mich., May 16-18, according to the announcement of the program. The subject will be discussed by Walter L. Fleisher, on Tuesday, the second day of the convention.

Other topics to be studied are: Certified Heating, discussed by C. P. Finke, and Welding, by John H. Zink. Walter Klie of Cleveland will report on the committee on trade promotion, and Robert D. Williams will describe the work of the committee on separation of contracts.

Two o'clock is the time set for convening on Monday, May 16, when President Ray L. Spitzley will open with an address, and conduct the business meeting.

Speed Work on Chicago Air Conditioned Tower

The first unit of the new 42-story Field Building, Chicago's largest office structure, is going up rapidly. A remarkable record was made in the construction of the exterior stone work—a floor a day, said to be the fastest job ever done in Chicago. A record also was made in the steel construction, 24 stories having been finished in 40 working days.

A two-pipe vacuum type of heating system, with an individual thermostatic control on each radiator, has been specified for the new building. All radiation, including pipes, both risers and laterals, and radiators, are entirely enclosed. The radiators themselves are hidden by metal enclosures with enamel finish to simulate the adjoining woodwork, and built into the walls, having no projection into office space. All steam risers are equipped with electrically-operated diaphragm valves, working on low voltage, and wired for push-button control from a central panel.

Four lower floors and the basement are air conditioned, and the balance of the building is equipped with an efficient ventilating system, with fans metered for current consumption.

Rockefeller Center to be Name of Development

Rockefeller Center is the name by which the development located between Fifth and Sixth Avenues, from 48th to 51st Streets, New York, N. Y., sponsored by John D. Rockefeller, Jr., will be officially designated, according to an announcement by the board of directors of the Metropolitan Square Corporation. The development has been generally referred to as Radio City, which grew out of the fact that about 20% of the rentable area of the project was leased by the Radio Corporation of America, and affiliated interests. The four buildings in the western part of the area leased by these interests will continue to be called Radio City.

New York Engineers Protest Public Works Cut

Curtailment of appropriations for public works construction was actively protested by the New York State Society of Professional Engineers at a meeting in Albany, N. Y., February 27. A resolution was adopted, and presented to Governor Franklin D. Roosevelt and the State Legislature, calling upon both to recognize their duty to increase the public works program.

District Steam for Duluth

Work has been started on a district steam system in Duluth, Minn.,

under plans originally made in 1929. The project is in charge of the Chicago investment house of Haskell, Scott & Byrne.

P. W. Chapman, New York bankers, originally attempted to raise the needed $1,800,000 in 1929, but due to market conditions were unsuccessful. The Chicago firm later conceived the idea of selling $1,500,000 worth of one-year 6% notes to the companies who would do the construction work and supply the equipment. By the end of the year it is hoped that market conditions will make possible a public offering of the bonds. At least, it is anticipated that it will be easier to sell bonds for a finished plant than for one existing only on paper.

Ninety thousand of the company's 100,000 shares of common stock have been trusteed, so that if the notes cannot be met, the contracting firms will receive the stock and be the owners. Haskell, Scott & Byrne will keep 10,000 shares for their share of the financing.

The new system will have its own generating plant. The contractor for the underground work is M. J. O'Neil, St. Paul. The Dohn Building Company will erect the buildings, and the plant and equipment will be supplied by the Edge Moor Iron Company. Several large manufacturers, among whom are Crane Company and Phillip Carey Company, will supply the material.

The generating plant will contain four 6000 sq. ft. boilers designed for a pressure of 450 lb. per sq. in., but expected to operate at 150 lb. Each boiler will be equipped with a 5-ton unit pulverizer and tubular air-preheater as well as fly-ash and cinder eliminators. A small house turbine-generator will supply power for auxiliaries.

Year-round operation, supplying steam at 150 lb. to the business district and certain industrial and process uses, is contemplated. The plant is expected to go into service in September of this year.

Why Pick on Allah?

By Ab El Pilauf

OVER the hot sands of the desert of depression, a weary contractor hastened toward the oasis of Banc Rupcee. On his feet, in place of socks, were stocks in many poorly financed buildings, and his boots were bonds of other speculative developments. They had long since ceased to help him in his travels, and now they hurt him at every step. Wearily he sank to his knees, as the sun of the profit was slowly sinking, and gazing toward the Mecca of Prosperity wherein he had so lately dwelt, he raised his voice in prayer.

"Behold in me, Oh Allah, a most melancholy wretch. Only three score years and ten have I to live upon this wart in thy universe. Thirty of these precious years have I spent in learning to run my business according to thy commands, Oh thou prophet of profits. Why then dost thou squirt upon me the vials of thy wrath? For during two of these years thou hast made me like unto a toad, hopping from thither to yon, and getting neither place.

"Behold, I have given tithes, I have succored the unfortunate, and now I am unfortunate with none to succor me. I have given a break to others and now I am broke. I am in fact a swell guy, if thou wouldst give me a break. Oh woe is me!"

Then the sirocco of the desert caressed him as he staggered into the bank. And the voice of Allah, borne upon this wind of adversity from a far place, caused him to prop out his ears and listen.

"Thou sayest thou has spent thirty years in learn-

Ice Industry Studies Comfort Cooling

Evidence that the ice industry is interesting itself in the subject of space cooling with ice is indicated by recent activities. At the twenty-fifth annual convention of the Illinois Association of Ice Industries, held at Danville, Ill., January 25-27, a discussion on the development and application of ice in this field was presented by George B. Bright and his daughter, Miss Elizabeth Bright, in the form of a dialogue.

Mr. Bright assumed the role of owner of the town's ice plant, and answered questions propounded by a prospective customer, impersonated by Miss Bright, who was introduced as the owner of the leading restaurant, in addition to a department store, and beauty parlor.

At the first convention of the Pacific Coast chapters of the National Association of Practical Refrigeration Engineers, held in San Francisco, February 17-18, considerable attention was given to the subject of space and comfort cooling with ice. H. N. Royden presented a paper on this subject, in which charts were used to show the installation and operating costs of plants in actual operation.

A typical installation was explained by W. H. Park, followed by an illustrated talk on small store application by H. T. Holbrook. The use of a similar system in a Los Angeles restaurant was described by Donald DeFremery.

In another paper presented to the conference, the operating engineer was urged to familiarize himself with developments in this field.

A paper on a similar subject was presented at the convention of the Southern Ice Exchange, held in conjunction with the Georgia Ice Manufacturers' Association, at Atlanta,

Ga., February 9-10. The paper was read by C. T. Baker, consulting engineer, Atlanta, in the absence of its author, Minor D. Woodling, of Kansas City. The flexibility of ice as compared with mechanical refrigeration, and the cost of cooling with ice, were discussed.

products and in the preparation of accurate, unbiased test data for catalog purposes.

A New York office of the laboratory has been opened at 30 Church Street, where Mr. Armagnac and Mr. Petersen will maintain their headquarters.

New Officers for Frost Research Laboratory

An expansion of the activities of the Frost Research Laboratory is indicated in the election of new officers at the annual meeting, held in Norristown, Pa., February 24. Robinson V. Frost, who established the laboratory in 1925, and who has directed its activities since that time, continues as president and director. The other officers are: A. S. Armagnac, vice-president, and Gustave Petersen, secretary-treasurer. Mr. Armagnac and Mr. Petersen were for many years associated together as publishers of HEATING AND VENTILATING. They will take an active part in the business management and promotion of the laboratory.

The laboratory will continue to specialize in the testing of heating boilers, domestic stokers, radiators, oil and gas burners, convectors, and air-conditioning devices. For the latter service the laboratory maintains a fully-equipped calorimeter test room in which any ordinary condition of temperature and humidity can be maintained, including the simulation of a rain storm.

Some of the largest industrial concerns of the country have been served by the laboratory, which has been successful in supplementing established research organizations in the development of new heating

ing to fructify thy business," said the voice of Allah, reproachfully. "Why, then, didst thou spend most of thy time three years ago at a ticker, guessing thou wouldst grab some easy jack? Hadst thou spent thy time gathering thirty buckets of camel dung, thou wouldst at least have something. Dost thou not know that mighty men have spent thirty years at the ticker untouched by other business, and then gone broke, and all their knowledge availeth them not?"

"Thou booteth me too hard upon the back of my lap, Oh Allah, and I am undeserving," wailed the poor stooge. "I did but do what other men did, even to the last hot tip."

"Yea, and even more so," thundered Allah in his most insulting loan-refusing tone. "Deduct the time thou spent at the ticker, and the time thou spent at golf, and the time thou spent making whoopee, from thy business, and thou well knowest why de ducks got thy black ink."

Then Allah had compassion. "Thou hast repented," said he in a hopeful voice, "go and sin no more. And in the future when thou art tempted to stray from the paths of thy business, remember to lay off that other guy's game thou wottest not of. And when thou art tempted to quaff the midnight gin that burns thy gizzard, burn thou rather electric juice in thy office seeking thy vanishing profits. Then when thou art tempted to make a pest of thyself about thy golf, use thy golf rather to stop the hardening of thy arteries and the falling of thy arches. Take heed unto these things, and thy shadow shall be long in the land of thy ancestors, and thy posterity, even if thou know not of them, shall make pleasant noises when speaking thy name."

Then the weary contractor muttered to himself and went forth into the market place where he hocked his car and bought fifty shares of cats and dogs on a thirty-point margin.

No Action Taken on Licensing Contractors

The New York State Legislature adjourned early in March without taking action on the proposal to license building contractors, referred to in these columns two months ago. Heating contractors were to have been included under the plan, which was designed to eliminate irresponsible contractors from the industry.

Committee of Ten Issues Bulletin on Chimneys

Educational Bulletin No. 1, devoted to the subject of Chimneys and How to Build Them, has been issued by the Committee of Ten, Coal & Heating Industries, Chicago, Ill. It is a discussion of design and construction of chimneys for residences, and is based largely on information contained in publications of the United States Department of Agriculture and the National Board of Fire Underwriters.

Tables of engineering data on sizes and heights of chimneys and flues are included. There is also a standard ordinance for chimney construction as recommended by the National Board of Fire Underwriters. Homer Linn has prepared a suggested contract specification. The bulletin is illustrated, contains 18 pages, and may be obtained from the Committee of Ten at fifteen cents the copy.

Heating to be Shown in World's Fair

Modern heating and air conditioning equipment will be exhibited and demonstrated in the Home and Industrial Arts Show of a Century of Progress Exposition, the World's Fair, to be held in Chicago in 1933.

Plans include eight modern homes, each to be constructed to meet a

different housing need, within which the manufacturers of equipment and furnishings will display their products. Space in the exhibition halls will also be allotted to the manufacturers of heating and air conditioning apparatus.

Contractors and Utility Reach Agreement in Colorado

An agreement has been reached between the local heating and plumbing contractors of Greeley, Colo., and the Greeley Gas & Fuel Company. The agreement provides that contractors will sell gas appliances handled by the company, as well as any other appliances approved by the American Gas Association, and will do the installation work on all gas appliances that the utility company sells to consumers.

It is stipulated that each contractor shall be responsible for his appliances, materials, and workmanship, and shall offer a one-year guarantee. The gas company may maintain salesmen to sell appliances, but these salesmen are required to arrange with the purchaser to have installation work done by the contractor in all cases. The company will stock appliances in contractors' stores, and will take a 10% commission on the appliance when sold.

Consumer Sales School for Contractors

A course in consumer selling methods, conducted under the auspices of the Educational Committee of the Chicago Plumbing Contractors Association, was started on the evening of March 10. The class will meet once a week, for eight weeks. Lee A. Marrs, Chicago, an experienced teacher of salesmanship, formerly connected with Northwestern University, and De Paul University, is the instructor.

For a textbook, the student's manual for consumer selling schools, prepared by the Plumbing and Heating Industries Bureau, is being used. Material in the manual is based on the actual sales experiences of more than 200 contractors in various parts of the United States, who have made an outstanding record in merchandising plumbing and heating equipment.

Ray A. Fergusen, Chicago, chairman of the educational committee of the association, advocates the formation of similar schools in other localities to meet the need for salesmanship in the industry. The same textbook is available to other associations, and no charge is made for supplying it. The Chicago bureau invites correspondence with officers of local associations everywhere regarding the institution of similar classes in their localities.

New York May Eliminate 30 C. F. M. Law

As Heating and Ventilating goes to press, the Mastick bill providing for the elimination of the 30 c.f.m. per pupil clause in the school building laws of New York State, and substituting instead "proper ventilation," has been passed by the state legislature, and is in the hands of Governor Franklin D. Roosevelt for signing.

If the governor takes no action on the bill it will become a law within thirty days. The governor vetoed the bill last year.

A. S. M. E. to Study Effect of Humidity on Paper

At the third annual meeting of the printing industries division of the A.S.M.E., held in New York, March 14-15, it was decided that the A.S.M.E. would form a committee to undertake research on the subject of humidity as it affects paper.

Among the technical papers of interest to air conditioning engineers was one by Carl W. Davis on "Humidity in the Pressroom."

Railroads Order 92 Conditioned Cars

The Baltimore & Ohio Railroad has awarded a contract for the installation of air conditioning equipment in 78 passenger cars. The work will be done in the company's own shops and is expected to be completed by June 1.

The Southern Pacific Company has ordered 14 air conditioned diners for delivery next spring.

Air conditioning and cooling systems are being installed on all dining cars of the Los Angeles Limited and San Francisco Overland Limited, crack trains running between Chicago and California, and will be placed in service in about two months, C. A. Cairns, passenger traffic manager of the Chicago & North Western Railway, announced.

Rowley Addresses A. S. H. V. E. Chapters

Prof. Frank B. Rowley, president of the A.S.H.V.E., accompanied by A. V. Hutchinson, secretary of the society, has completed a tour on which he addressed a number of the chapters in the east and middle west, following the annual custom of the holder of that office. Professor Rowley's talk was on the subject of "The Future of Heating and Ventilating," and in it he outlined and explained the research work of the society. Slides were used to illustrate the methods employed in determining coefficients of conductivity in various materials and types of wall construction.

Among the chapters that have heard Professor Rowley are Chicago, Cleveland, Kansas City, Detroit, Pittsburgh, and New York. The president prefaced his remarks with a brief discussion of the problem of society membership, and told of a movement to establish a new chapter at Cincinnati, Ohio.

Home Loan Bill Lingers in House

Hearings on the Luce bill were conducted March 17 by the Reilly sub-committee of the House Banking and Currency Committee. The bill provides for the establishment of 12 Federal home loan banks, to discount residential home mortgages.

Early action was urged by Lawrence T. Stevenson, president of the National Association of Real Estate Boards, who appeared as a witness before the committee. He stated that a system of home loan banks was more needed as a permanent measure than as an emergency measure.

Gen. Nathan William MacChesney, of Chicago, counsel for the association, another witness, testified in favor of the bill, and advocated a number of amendments designed to improve the measure. He suggested that the bill be broadened to include mortgage brokers as potential borrowers, through member institutions. Mr. MacChesney favored tax exemption on the bonds and debentures of the banks, but agreed that it would be acceptable to amend the bill so that dividends would be paid to the Government on its stock, as they would be to other stockholders.

Among other witnesses were Chesla C. Sherlock, managing editor of the *Ladies' Home Journal,* who cited the decline of the percentage of home ownership in the nation. O. K. La Rocque, deputy insurance commissioner of North Carolina in charge of building and loan associations, testified that there was a demand in his state for loans that cannot be met by the sound and solvent, but thoroughly unliquid, associations. William C. Ermons, New Orleans, president of the New Orleans Homestead Clearing House Association, representing homestead and building and loan associations in Louisiana, advocated funds for repair and reconstruction of buildings.

Accident Prevention in Building Trades

With the close of 1931, the Accident Prevention Committee of the Building Trades Employers' Association of the City of New York completed its fifth year of activity along the lines of investigation and study of personal injury accidents to workmen occurring during the erection of buildings, and the dissemination of accident prevention information. Continuance of the work throughout 1932 has been approved by the board of governors of the association.

From one standpoint, this work has assumed greater importance with the decline in building activity. As employment goes down, total payroll and insurance premiums are reduced, yet the hazards of the work may remain the same. In fact, such payments have become a larger ratio in proportion to the reduced premiums. All this has a trend to increase the rates of compensation insurance, as has been evidenced during 1931.

RKO Gets He-Man from Heating Industry

Creighton Chaney, son of the late Lon Chaney, who recently left his position with the General Water Heater Company to become a featured movie actor with RKO. Mr. Chaney will play he-man parts.

Coal Association Increases Membership

An increase in membership of nearly 50% over the enrolment of March 31, 1931, has been reported by the National Retail Coal Merchants Association. Also the number of affiliated associations has been brought to a total of 98 by the addition of 31 new groups.

This expansion has extended the organization into five states having no membership a year ago.

Dust Collector Research Discussed by New York A. S. M. E.

Results of extensive experiments to study the operating characteristics of cyclone dust collectors, recently carried on through the cooperation of the Brooklyn Polytechnic Institute, the Prat-Daniel Corp., New Rochelle, N. Y., and an associated French company, were reported by Louis C. Wheaton, Jr. at a meeting of the fuels division of the metropolitan section of the A.S.M.E., February 18.

Cyclone collectors having diameters of 1 ft., 2 ft., and 3 ft. were used in the test, and these were connected by ducts through a fan to a gas-fired furnace. A hopper was placed between the furnace and the fan, through which the dust was introduced. The height of the cyclones, location of the outlets, and shape of the bottom cones were adjustable, permitting 108 variations of design for each collector tested.

Effects of the following considerations on the collection of dust were investigated: collector diameter, collection velocity and temperature, mesh of dust, grain loading, arrangement of the outlet pipe at the bottom of the cyclone, and the rate of emptying the cyclone.

Experts Disagree on Responsibility for Smoke

At the meeting of the New York section of the American Institute of Electrical Engineers, held March 8, Dr. E. E. Free, consulting engineer, and professor at New York University, ascribed the blame for more than 90% of New York's smoke nuisance to apartment houses, homes, and other small users of fuel. In the discussion that followed, this statement was contested by Col. Elliott H. Whitlock, who stated that the larger plants are the chief offenders.

It was generally agreed that wind is an important factor in determining the degree of smoke nuisance, and that recently-noted improvements in smoke abatement are the combined result of the drive on smoke offenders, a mild winter, and reduced fuel consumption due to the current curtailment of industrial activity.

Two reasons were advanced for the greater smoke from apartment and domestic fires. One is the very large number of users in this classification, and the other lies in the fact that the janitors and firemen operating these small plants are not instructed in the advantages of running without smoke, and that it is difficult to bring pressure to bear to

force them to do so. Smoke from the stacks of a large plant will result in immediate complaints and drastic action, however.

Manhattan Island is relatively free from smoke when the wind is blowing from the northwest, but a wind coming from the southwest carries with it much smoke pollution from the congested districts of New Jersey. A complete lack of wind leaves the local smoke stationary, and greatly increases the nuisance. Rain and snow have been found to have relatively little effect in clearing the atmosphere of smoke particles, other than cinders.

Heat Loss Calculator

A slide rule for determining heat losses and calculating radiation has been placed on the market by Warm Air Heating, 105 S. Ninth St., St. Louis. The price is $1.50, postpaid.

Steam Sales Pick Up in Baltimore

The 1931 report of the Consolidated Gas, Electric Light and Power Company of Baltimore shows an increase of 9.37% in steam sales over 1930, although electric sales increased only 0.46%, and gas revenue declined 0.29%. The steam sales in 1931 were $471,146.

Oregon Engineers Hear Talk on Air Conditioning

J. W. De Young, Portland architect, spoke before the Oregon section of the A.S.M.E., February 26, on the air conditioning equipment of the Paramount Theater building, in the engine room of which the meeting was held.

Harry Brod, Portland district manager of the B. F. Sturtevant Company, spoke on "Modern Air Conditioning Equipment."

British Engineers to Visit America

The annual summer meeting of the British Institution of Mechanical Engineers this year will be held in Canada and the United States, August 27-September 9, inclusive. Members of the institution will arrive at Quebec August 27, and proceed to visit industrial plants, power stations and other places of interest in eastern Canada and the United States.

COMING EVENTS

APRIL 6-7, 1932. Spring Meeting of the Central Supply Association to be held in Chicago, Ill. Headquarters at the Palmer House.

APRIL 11-16, 1932. Ninth Annual Convention and Oil Burner Show of the American Oil Burner Association, Mechanics Building, Boston, Mass.

APRIL 14-15, 1932. Fifth Midwest Bituminous Coal Conference, Purdue University, Lafayette, Ind.

APRIL 20-30, 1932. National Home Building and Home Ownership Exposition, to be held at the Grand Central Palace, New York.

APRIL 27-29, 1932. Annual Meeting of the American Welding Society, Engineering Societies Building, New York.

APRIL 27-29, 1932. Sixty-Fifth Convention of the American Institute of Architects, to be held in Washington, D. C.

MAY 9-11, 1932. Annual Meeting of the Natural Gas Department, American Gas Association, to be held in Tulsa, Okla. Headquarters at the Mayo Hotel.

MAY 9-11, 1932. National Pipe and Supplies Association Convention, to be held in Pittsburgh, Pa. Headquarters at the William Penn Hotel.

MAY 16-18, 1932. Forty-Third Annual Convention of the Heating and Piping Contractors' National Association, to be held in Detroit, Mich. Headquarters at the Book-Cadillac Hotel.

MAY 18-19, 1932. National Warm Air Heating Association Convention, to be held in Columbus, Ohio. Headquarters at the Deshler-Wallick Hotel.

MAY 23-25, 1932. Annual Convention of the American Boiler Manufacturers Association, to be held in White Sulphur Springs, W. Va. Headquarters at the Greenbrier Hotel.

JUNE 6-10, 1932. Twenty-Fifth Annual Convention and Exposition of the National Association of Building Owners and Managers, to be held in Chicago. Headquarters at the Drake Hotel.

JUNE 14-17, 1932. Annual Convention of the National District Heating Association, to be held in Pittsburgh, Pa. Headquarters at the William Penn Hotel.

JUNE 20-23, 1932. Fiftieth Annual Convention and Exhibit of the National Association of Master Plumbers, at Madison Square Garden, New York.

JUNE 26-30, 1932. Semi-annual Meeting of the American Society of Heating and Ventilating Engineers, to be held in Milwaukee, Wis.

JUNE 27-JULY 1, 1932. Semi-annual Meeting of the American Society of Mechanical Engineers, to be held in Bigwin, Canada.

Buffalo Engineers Discuss Electric Power Development

An address on the electrical development of the Niagara frontier was delivered by A. G. Smith, general sales manager of the Buffalo General Electric Company, at the regular monthly meeting of the Western New York chapter, A.S.H.V.E., March 14. Mr. Smith outlined the application of power to industrial uses.

Albert A. Cryer

Albert A. Cryer, president of the D.G.C. Trap and Valve Company, New York, died on January 31.

A charter member and one of the organizers of the A.S.H.V.E., Mr. Cryer served as a member of the council from 1894-1898.

Mr. Cryer is survived by his widow and son.

With the Engineers

Ball and Snyder, consulting engineers, have removed their offices to 110 West 40th St., New York.

J. M. Aikman has opened an office at 702 Minnesota Building, St. Paul, Minn., where he will engage in consulting engineering. Manufacturers are requested to place his name on their mailing list for catalogs.

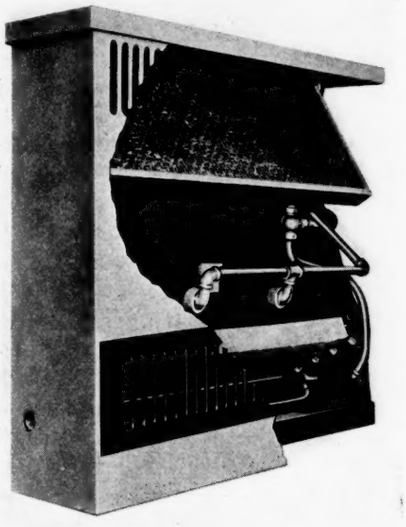
Everett S. Buck, designer of the gas-fired heating system made by The General Iron Works Company, has opened an office at 55 Sheehan Ave., Cincinnati, Ohio, where he will engage in a consulting engineering practice, specializing in air-conditioning consultation for manufacturers.

George W. Martin, supervising engineer of the United States Realty and Improvement Co., New York, is representing the National Association of Building Owners and Managers on the following A.S.M.E. sub-committees: wire rope research; steam traps; standardization of brass plumbing products; copper water tube fittings; code for pressure piping. Mr. Martin is also serving as chairman of the research committee of the management division of the Real Estate Board of New York.

New Equipment

Carrier Home Humidifier

Development of a home heater and humidifier, designed to operate in conjunction with an ordinary radiator heating system in dwellings and apartments, has been announced by the Carrier Corp., Newark, N. J. The unit uses the same supply and return pipes available in the present heating system, and supplements, but is not intended to replace, existing radiation. Small water supply and drain pipes are added for humidification.



Cabinet type humidifier

Units are available in two models. When used above the first floor, the apparatus is enclosed in a cabinet, standing 25 in. high, and 26 in. long by 7 in. wide. Air at the floor level enters through the lower grille, and is warmed by the heating coil, attached to the regular heating system. It then enters the upper portion of the cabinet where it is humidified by a finely atomized spray of water. Before passing back into the room through the upper grille, the air is cleansed by traversing a filter screen. Circulation is effected by the natural tendency of the warmed air to rise, setting up convection currents drawing in the cold air at the bottom, and discharging the warmed air at the top. Cabinets are furnished in grained mahogany, or may be had primed in gray, to be finished to suit the owner.

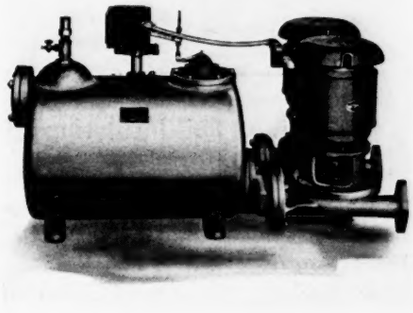
The model designed to supply the first floor is suspended from the cellar ceiling, the grille opening being the only part visible from above the floor. This opening is 12 in. wide by 26 in. long, and is divided to take air in at one end and discharge it at the other. Either forced or gravity circulation can be used with this type. With forced circulation, the lower portion of the suspended unit houses a motor, operating from an ordinary lighting socket, which drives two fans.

The apparatus uses approximately 2½ gal. of water per hr., and actually evaporates about three quarters of a gallon. It is claimed that a single unit will maintain a relative humidity of approximately 32% in an average small house.

Skidmore Duplex Condensation Pump

A duplex condensation pump has been added to its line of vacuum and condensation pumps by the Skidmore Corp., St. Joseph, Mich. Similar to the single units, the new pump has a cast iron receiver, shrouded impeller, wearing rings, and sleeve protection for the extension of the motor shaft through the stuffing box.

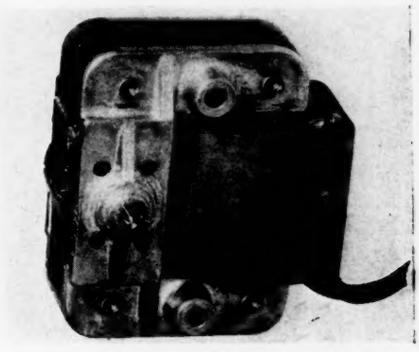
Removal of six cap-screws permits the pump and motor assembly to be taken out for inspection, without disturbing the piping. Units are built in sizes ranging in capacity from 2000 sq. ft. to 40,000 sq. ft. of radiation. Pressures range from 10 lb. to 120 lb. Exceptionally quiet operation is claimed.



Condensation pump

Motor for Fans and Unit Heaters

A fractional horsepower motor, for use on fans and small unit heaters, has recently been announced by Automatic Products Co., 121 N. Broadway, Milwaukee, Wis. The motor is of the squirrel-cage type,



Fractional hp. fan motor

and has oilless bearings mounted in bosses cast in the side plates. Quietness of operation and freedom from radio interference are claimed.

Motors can be supplied for voltages of from 10 to 230, and for frequencies of from 25 to 60 cycles.

Barber-Colman Surface Thermostat

Barber-Colman Co., Rockford, Ill., has announced an electrically-operated surface thermostat. The device is designed to be strapped or clamped to the external surface of a tank, pipe, vat, duct, or other metal container, in which it is desired to control the temperature.

A copper disk in the base of the instrument collects heat from the surface of the container and transmits it through a copper stud to the center of a bi-metallic disk, which is the sensitive element of the control. This disk dishes or flattens with changes of temperature, and its motion is transmitted through a yoke

and moulded thimble to a bell-crank and so to a tongue mounted in such a way as to move between two fixed contact points. As this tongue is moved from one point to the other by the warping of the disk, it closes one or the other of the two circuits of the regular three-wire control system. Detent magnets are mounted alongside the tongue to provide snap-action shifting from one circuit to the other.

The surface thermostat is designed for use in conjunction with other instruments which combine to make up a three-wire low-voltage system of temperature control. The

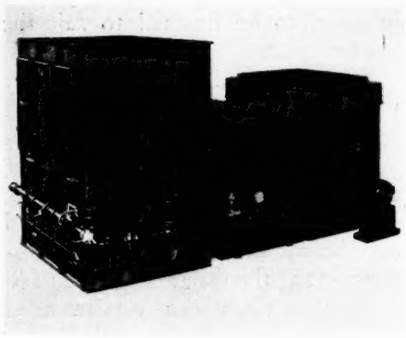
Barber-Colman surface type thermostat

standard instrument may be adjusted for any temperature between 100° and 200°, and has a differential of 10° to 12°. They may be made for other ranges and for operation on a differential as low as 4°.

Climator Domestic Air Conditioner

L. J. Mueller Furnace Co., Milwaukee, Wis., is manufacturing a domestic air conditioning furnace called the Climator. Equipment is supplied either as a complete unit, comprising a gas-fired warm-air furnace, air washer, fan, and air filters, or the separate units may be purchased to be added to existing warm-air heating systems.

Air from the rooms is drawn through the return ducts by the fan, and passed through cellulose fiber filters, where dust and soot are removed. It is then forced into the washer where the air is washed and humidified before being warmed in



Climator air conditioner

the furnace. The conditioned air is delivered to the rooms at a positive pressure. Dehumidification and cooling are effected in hot weather by operating the system without the furnace. Fan speed can be adjusted to regulate the rate of discharge. Capacities range from 1400 to 6300 cu. ft. per min.

Lenahan Gas and Steam Coil

Daniel W. Lenahan, 185 West End Ave., New York, has announced a gas-fired heating coil for use in garages, chicken houses, and work shops. The end of a standard steel pipe coil is carried over a gas burner in the heating chamber. The heating chamber is made of asbestos mill board covered with planished iron. Openings into the heating chamber and around the down-draft divertor are covered with No. 24 gauze.

It is claimed that tests show that it is possible to spray gasoline over the heater without causing an explosion.

Aluminum Foil Insulating Material

Aluminum foil insulating material is being introduced by Alfol Insulation Co., Chrysler Building, New York, N. Y. Application of this material for such a purpose has been made in Europe on refrigerator cars and trucks, steam and exhaust lines, and similar uses.

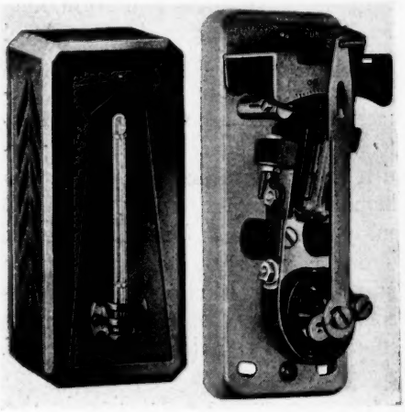
The foil is applied either in sheets, retained about 1/3 in. apart by strips of other material, or crumpled between sheathing, which serves to support it. Advantages claimed for this kind of insulant are its high thermal efficiency, negligible weight, low heat retention capacity, imperviousness to moisture, and cleanness in application and use.

The heat transmission of Alfol, crumpled, is reported as about 0.30 B.t.u. per in. per sq. ft. at a mean temperature of 100°.

Mercoid Sensatherm Temperature Control

A low voltage mercury contact thermostat for air temperature control, known as the Mercoid Sensatherm, has recently been announced by the Mercoid Corp., 4201 Belmont Ave., Chicago, Ill. The device is designed for use with the Mercoid transformer relay on alternating current, or with the Mercoid repulsion relay on direct current.

Moving parts are hermetically sealed into the switch. The instrument is operated by a spiral bimetallic element, one end of which is attached to the range adjustment lever, and the other carries a small permanent magnet. When the temperature falls below the point for which it is set, the magnet is moved into close proximity with the mercury switch. A movable armature within the switch is attracted toward the magnet, and the mercury cup is moved into such a position as



Open and closed views of Mercoid Sensatherm

to close the circuit between fixed contacts.

An increase in temperature draws the magnet away from the mercury switch, and when the pull of the magnet can no longer hold the armature, the mercury cup is moved away from the contacts.

A differential of 1°, or ½° above or below the point for which it is set, will normally operate the control, but adjustment can be made to permit operation on 2° variations, where such condition is desirable.

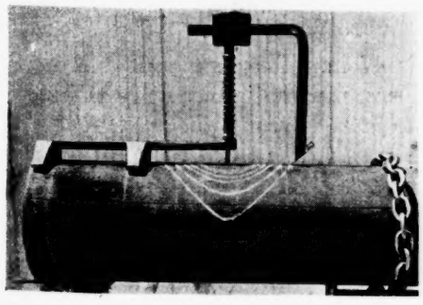
Vallen Adjustable Volume Fans

The Vallen Electrical Co., Inc., Akron, Ohio, has placed on the market an adjustable volume ventilating fan. The axle of the fan is at right angles to the motor shaft, and is geared through an extending arm. The unit may be suspended from supports attached to the duct system, or it may be mounted on wall, ceiling or floor. The pitch of the blades may be adjusted to meet varying delivery volume requirements by loosening tie-bolts in the fan hub, and rotating the blades into new pitch positions. Marks on the hub and blade fix these positions.

Four sizes are available, with capacities ranging from 520 c.f.m. to 6880 c.f.m.

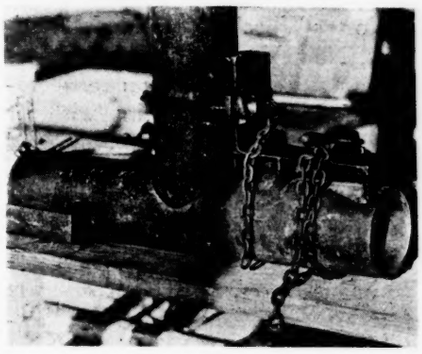
Jewel Pipe-Welding Tools

Jewel Mfg. Co., St. Paul, Minn., is marketing a line of welding tools for the steamfitter, two of which are illustrated. The first is the pipe marker, which will mark a perfect hole and saddle on any pipe between 2½ in. and 8 in. in diameter. A larger size is obtainable which may be used with pipe up to 20 in. A beam having legs forming V-shaped notches supports the centering point and the marking arm.



Jewel pipe marker

The angle clamp uses V-shaped notches to line up the header and branch in position, and a chain clamp on each side holds the two pieces rigidly in place until the weld is complete. It will handle any size of pipe or main from ½ in. to 12 in.



Angle clamp for welding

Indicator-Recorder for CO_2 and Combustibles

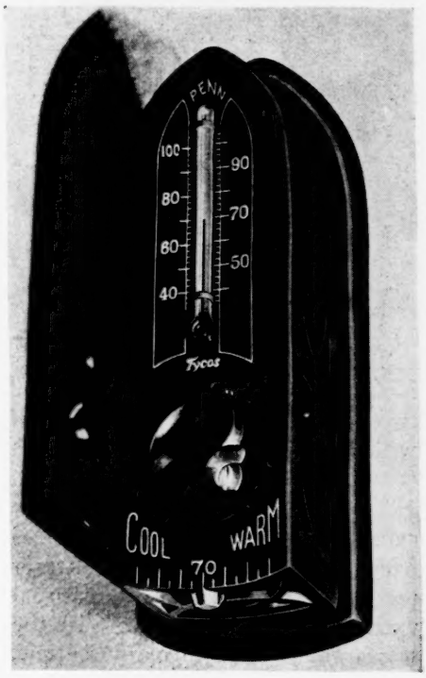
C. J. Tagliabue Mfg. Co., Park and Nostrand Aves., Brooklyn, N. Y., has announced the Tag-Mono indicator-recorder, an all-metal automatic flue gas analyzer. The instrument indicates and records the proportion of combustible, represented by $CO + H_2$, present in the flue gas, as well as the amount of CO_2, in per cent. Thus, the operating engineer has an accurate check on the completeness of combustion, and some indication of the amount of fuel value unburned.

Operation of the instrument is based on the chemical analysis of the Orsat principle, with an electrical indicating and recording device. An illuminated dial on the indicating part of the instrument makes possible reading at a distance of 30 ft. A 9-in. 24-hr. circular chart enables the engineer to make studies of the continuous performance of the boiler.

Penn Electric Room Thermostat

Penn Electric Switch Co., Des Moines, Iowa, is introducing a room thermostat, known as Type C. The control will operate on either line or low voltage without change, and is applicable to both two and three wire systems. It is adaptable for use with the Penn stack switches now available, for either line or low voltage, intermittent or continuous ignition.

Operation is by means of a magnet contact, and it is claimed that the total differential is less than 1½°. Attention has been given to the design of the bakelite cover, not only with the appearance in mind, but also with a view to permit a free circulation of air, and assure sensitive operation.



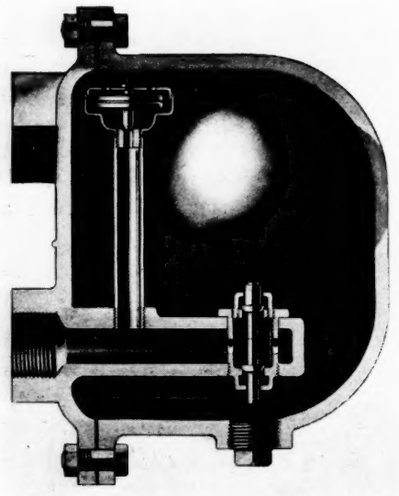
Penn room thermostat

Hoffman Float and Thermostatic Traps

A line of float and thermostatic traps has been placed on the market by the Hoffman Specialty Co., Waterbury, Conn.

The float valve is double-seated, permitting the use of a direct-acting float, resulting in a unit of compact construction. The position of the float insures a water seal over the ports at all times, preventing loss of steam into the return. Initial or entrained air is by-passed through

a valve controlled by a thermostatic element located above the water line. The body casing can be removed for cleaning and inspection purposes without disturbing pipe connections.



Thermostatic and float trap

The trap operates at pressures as high as 30 lb., and is furnished in two sizes. The smaller is furnished with 1 in. or 1¼ in. inlet and outlet connections, and the larger with 1½ in. or 2 in. connections. The capacity of the smaller trap ranges from 2250 lb. to 6600 lb. of water per hr., as the pressure differential varies from 1 lb. to 30 lb. With the same range of pressure differentials, the larger trap will discharge from 3090 lb. to 12,550 lb. of water per hr.

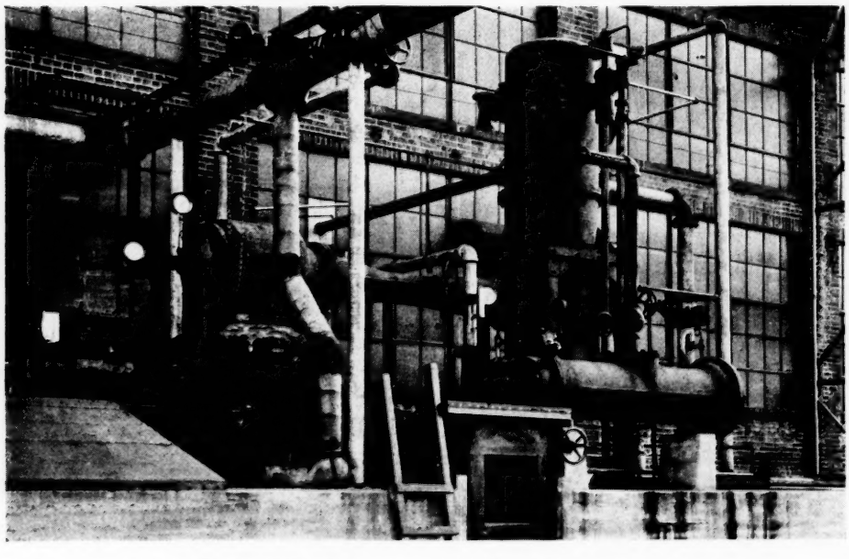
Vacuum Refrigeration System

Foster Wheeler Corp., 165 Broadway, New York, N. Y., has developed a system of vacuum refrigeration for use in connection with air conditioning in public buildings and industrial plants wherever there is a supply of steam for operating the equipment. The principle employed is similar to that applied in the experimental cooling of railroad cars (see page 75, HEATING AND VENTILATING, October, 1931).

Water to be cooled is piped into a chamber in which a high vacuum is maintained. The warm water will boil at a relatively low temperature, due to the reduced absolute pressure, and will be cooled as a result of supplying heat for the evaporation of a small quantity of water.

Low absolute pressure in the flash chamber is maintained by a steam ejector consisting of a group of steam nozzles directed toward an entraining throat. Steam is introduced into these nozzles, and in passing through them attains a high velocity, entraining the vapors entering the suction opening of the ejector, and compressing both the vapors and the actuating steam to a pressure for which the condensing temperature is higher than that for the normal water supply.

An electrically-driven pump removes the water fom the flash chamber, and circulates it through the cooling system. Another pump circulates the water in the condenser circuit. The high vacuum is maintained in the condenser by a small two-stage steam-operated air jet pump.

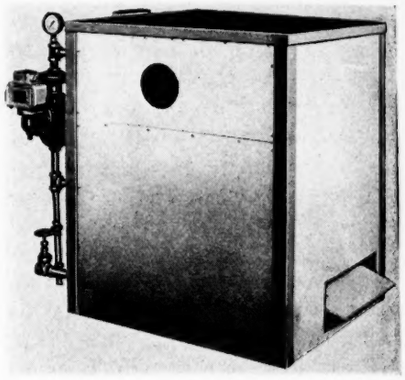


Foster-Wheeler vacuum refrigeration system

Thermez Gas Boilers

The Dunkirk Radiator Corp., Dunkirk, N. Y., has announced the Thermez gas boiler, for use either in steam or hot water heating systems.

Constructed of cast iron, the sections are so designed that a staggered zig-zag flame path is made between them. The apparatus is enclosed in an insulating jacket. Air for combustion is drawn in through the top and over the back of the boiler, where it is preheated. The air door is automatically closed when gas is shut off to retard cooling down of boiler. To decrease head room required, and to prevent the condensation from dripping on to the top of the boiler and controls, the draft hood has been removed from the top of the boiler and placed to the rear. The boilers may be conveniently joined together in close contact in large installations, forming a single unit.



Dunkirk Thermez gas boiler

The overall height of the boilers is 47 in. They are available in 18 sizes, ranging in output from 76,800 to 960,000 B.t.u. per hr.

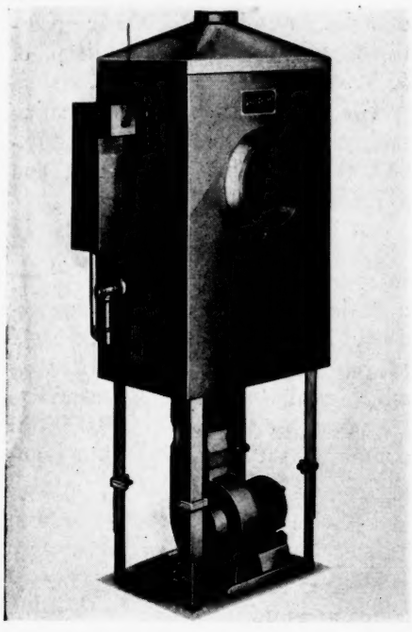
Humidifier Uses Waste Heat for Evaporation

Minneapolis Air Conditioner Co., Minneapolis, Minn., is marketing a

product called the Tropico, which utilizes the waste heat in flue gases in the heater stack.

The device is connected into the stack, as near to the boiler as possible, and the hot gases circulate about and impinge against a water section. Cold air is drawn from the living rooms, and is forced around the heat chamber of the humidifier by means of a blower. Here it is warmed, and in passing over the open top of the water section it receives moisture from the evaporation of the water. The amount of water evaporated is automatically controlled by a valve connected to the water section. As more heat is applied, the amount of moisture added is increased. The warmed and humidified air is discharged back into the living rooms through a duct and grille.

Legs are adjustable, to permit the apparatus to be connected to any height of chimney. It is said to evaporate as much as 35 gal. of water per day.



Tropico humidifier

York Railroad Car Air Conditioning Equipment

An all-electric air conditioning and refrigerating system, for railroad passenger cars, has recently been announced by the York Ice Machinery Co., York, Pa. The use of a motor-driven generator set is eliminated, and direct cooling is used, reducing space requirements and weight of equipment.

Power is supplied direct from a three-brush generator, driven by the car axle and floating on a large storage battery. Generator and compressor are mounted on a steel frame beneath the car. This combination of axle-driven generator and high capacity storage battery permits each car system to operate independently of the position of the car, and regardless of whether the car is in motion or not. It can be adjusted to meet the requirements of any run as to period of precooling, speed, length of run, stops, etc.

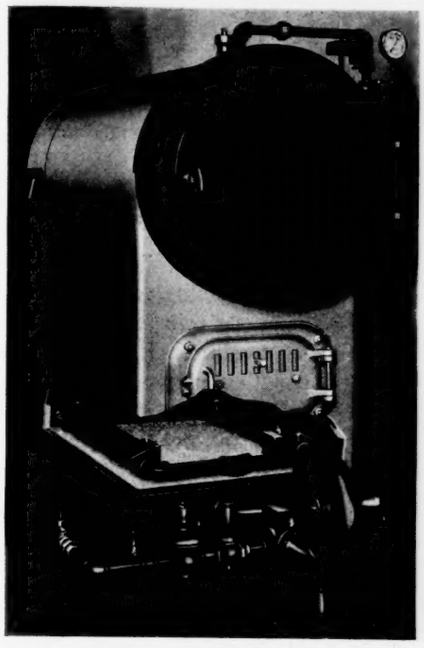
Dichloro - difluoromethane, commonly known as freon, or F-12, is the refrigerant used. Advantages claimed for this gas, developed by the Kinetic Chemical Company, Inc., are that it is odorless, colorless, non-corrosive, non-combustible, and non-inflammable. It is said to be practically non-toxic.

Air is drawn from the car into the air conditioning unit beneath the ceiling at one end of the car. Here it passes over the frosted fin surface cooling coils, containing the liquid F-12. If desired, air from outside may be mixed with the recirculated air, by drawing it in through a grille in the ceiling of the vestibule. Replacement air is filtered before it is circulated in the car.

Conditioned air is discharged into a duct along one side of the car in the space usually devoted to ventilators. Duct outlets are equipped with deflectors to prevent drafts.

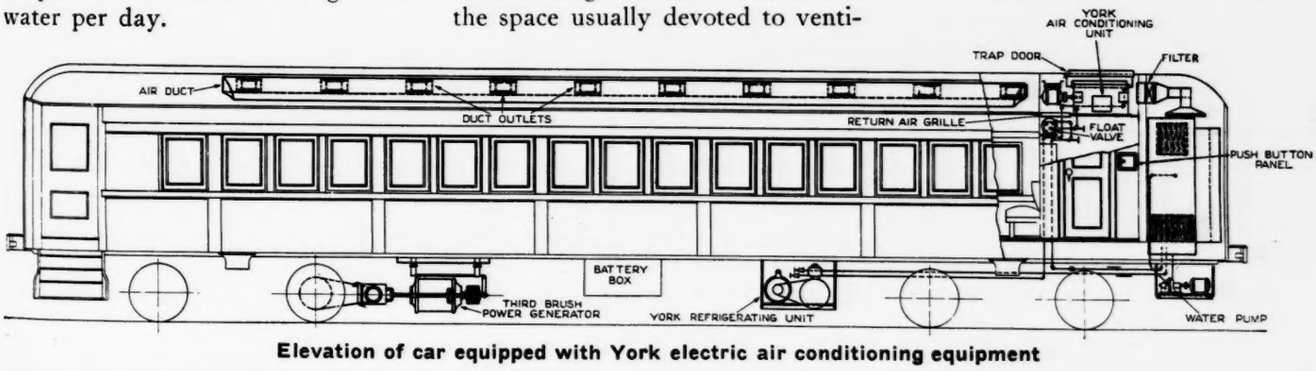
R & M Gas Heat Unit

Robbins & Myers Gas Appliances, Inc., Springfield, Ohio, is manufacturing the R & M gas heat unit, a power type conversion burner, adaptable to all types of warm-air furnaces and boilers.



Cutaway view of gas burner

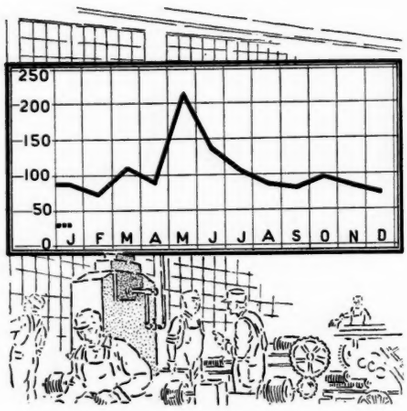
Burners are equipped with automatic controls, including limit controls. A motor-driven blower and proportioning valve maintain the correct mixture ratio of gas and air. A pressure reducing valve is used to regulate the pressure of the fuel gas to suit the requirements of the kind of gas burned. It is said that the apparatus is practically noiseless in operation.



Elevation of car equipped with York electric air conditioning equipment

Business Statistics

(Solid line in charts, 1931; dotted line, 1932)



Air Washers and Air Conditioning Units
Orders in Dollars
January, 1932, 29,599; January, 1931, 87,570; decrease over last year, 66%.

Those who closely follow the production charts which have appeared each month in this department, based on data supplied by the Department of Commerce, may note that figures given for 1931 with several of the charts do not agree with data published in the past issues. The reason is that the Department has been able to persuade eight additional manufacturers to report on air conditioning equipment. These figures were made available retroactive to January 1, 1931. Thus, last year's figures have been increased.

Although commodity prices are still dropping, Col. Leonard P. Ayres, vice-president of the Cleveland Trust Company, says that:

"At the bottom of previous depressions, however, the averages of prices have sometimes continued to decline after the volume of industrial production has begun to increase."

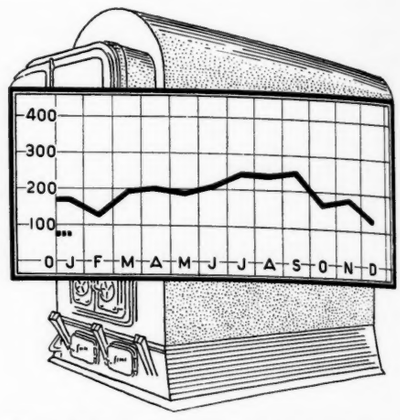
Generally, he finds March business conditions much improved over preceding months. The improvement is in the fundamentals rather than on the surface, but it is present in fact, even though it is to but slight degree reflected in the figures.

As if the continued mild weather were not enough grief to the anthracite operators to bear, an outlaw strike has been called in the Wilkes-Barre fields which has affected several mines. The United Mine Workers have ignored the strike but state that it was called by idle miners formerly employed at mines closed at present, and who are now trying to force employed men out.

A tabulation of industrial corporation profits, reported by the National City Bank of New York, classified by type of product, shows that 15 heating and plumbing manufacturers had net profits of $8,826,000 in 1930, and a deficit of $935,000 for 1931.

Profits of heating and plumbing manufacturers compare quite unfavorably with the total of all industries, numbering 900 corporations, which showed a drop of 52.9% in profits.

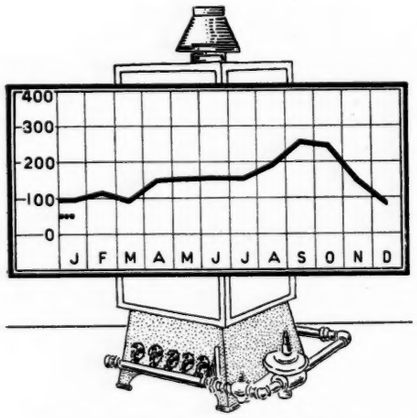
The net worth of the 15 heating and plumbing concerns was $76,617,000 on January 1, 1930, and $77,971,000 in 1931.



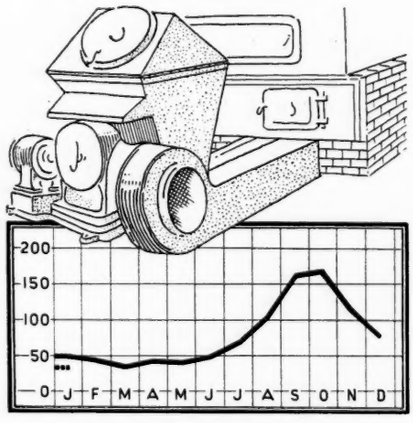
New Orders for Steel Heating Boilers
In Square Feet of Heating Surface
January, 1932, 74,950; January, 1931, 169,907; decrease over last year, 56%.

A decided upturn in building activity in the South was reported March 2 by *Manufacturers Record*, which said that February contracts let amounted to $77,000,000, as compared with $57,000,000 in January.

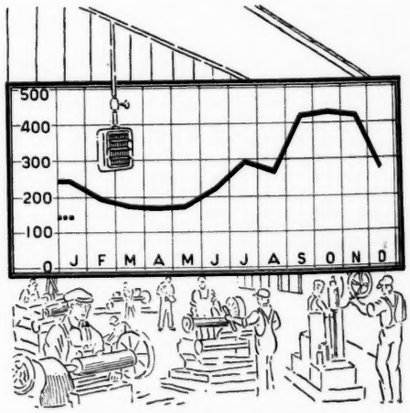
Revised hourly wage rates for the Chicago building trades, which be-



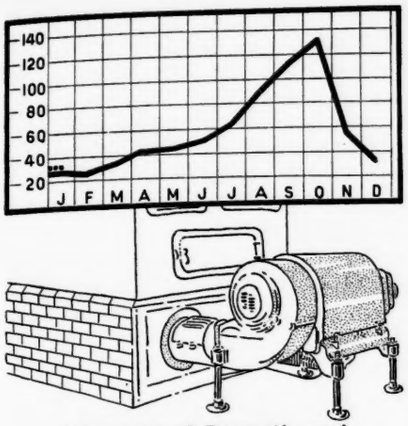
Shipments of Gas-Fired Boilers
In Thousands of B.t.u. Capacity
January, 1932, 54,274; January, 1931, 98,397; decrease over last year, 45%.



Mechanical Heating Stokers
In Number of Units Installed
January, 1932, 338; January, 1931; 500; decrease over last year, 32%.



Unit Heaters (Industrial)
Orders in Dollars
January, 1932, 144,260; January, 1931, 240,576; decrease over last year, 40%.



Shipments of Domestic and Commercial Oil Burners
In Number of Units
January, 1932, 3190; January, 1931, 2799; increase over last year, 14%.

came effective March 11, included a rate of $1.37½ for sheet metal workers, steamfitters, and plumbers.

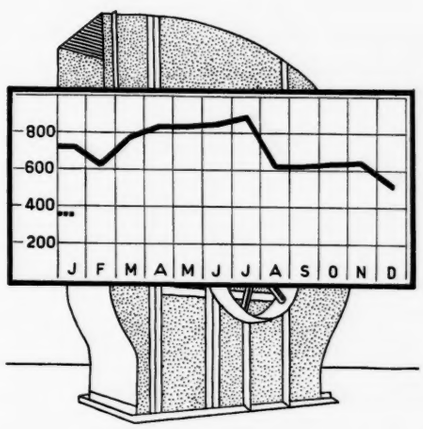
Cleveland steamfitters have accepted a reduction of $2 per day.

February building permits issued in 583 cities and towns were valued at over $45 million, a decline of 6% from the preceding month, according to S. W. Straus & Company. The February total was 59.4% under the same month of last year.

A survey of 17,000 representative farms throughout the country revealed that 38% of the mortgaged farms were mortgaged for more than half their value, as of January 1, 1931, according to the Bureau of Agricultural Economics, U. S. Department of Agriculture. The most favorable condition existed in New England, where more than 80% of the mortgaged farms covered by the survey were mortgaged for less than 50% of their value.

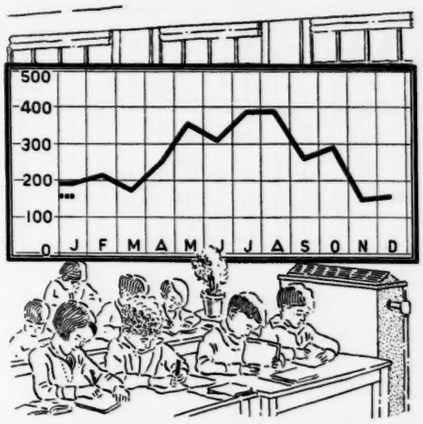
Construction contracts awarded in the 37 states east of the Rockies amounted to $51,764,800, during the first 15 days of March. Non-residential buildings accounted for $21 million; residential, $19 million; public works, $12 million.

In connection with the report on vacant apartments in Manhattan, published on these pages last month, the Tenement House Bureau of New York in another survey determined that the vacancies in the Bronx amount to 9.7%, as compared with 5.8% in 1927.



Fans and Blowers
Orders in Dollars
January, 1932, 360,611; January, 1931, 719,660; decrease over last year, 50%.

The chart shown below reviews the data supplied by the Department of Commerce on oil burner shipments. It is important to note that the curve is based on shipments, not on new orders, and that it covers domestic and commercial burners, as distinguished from industrial, and that only shipments in the United States are covered, so that exports are not included.



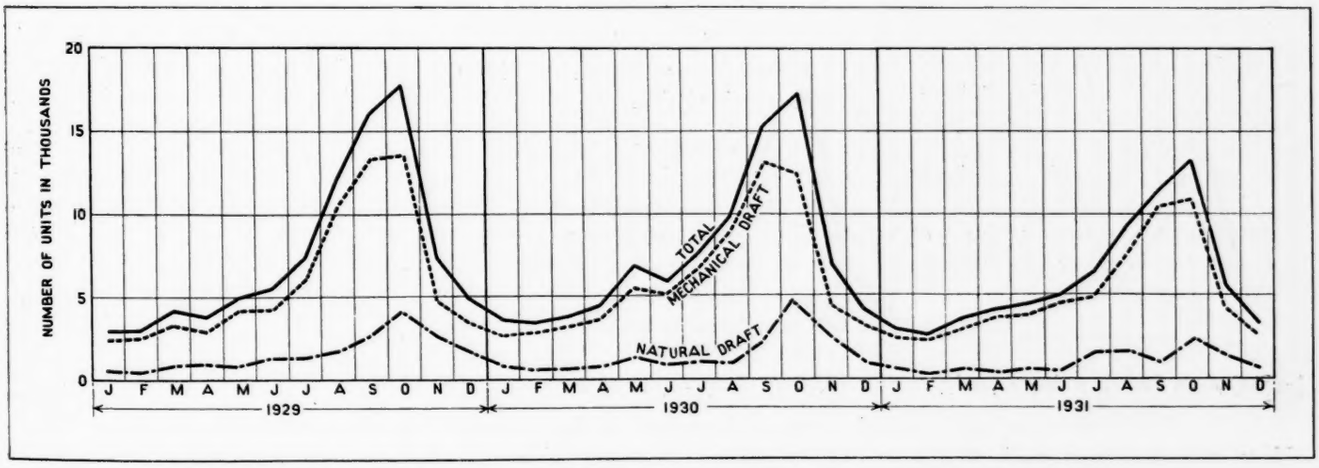
Unit Heaters (Schoolroom Type)
Orders in Dollars
January, 1932, 158,299; January, 1931, 196,359; decrease over last year, 19%.

The following table shows the figures as totaled for each year:

	Mechanical Draft	Natural Draft	Total
1929	71,078	18,830	89,908
1930	71,434	17,588	89,022
1931	60,133	10,936	71,069

Mechanical draft burners fell off 15.9% in 1931, as compared with 1930. For natural draft burners the drop was 37.8%, the combined decrease being 20.2%.

National Real Estate Mortgage Survey, published by Nelson, Hunt & Co., Chicago, reports an upward trend, the first in recent months, in dollar volume of real estate mortgages. January figures for leading cities amounted to $182,546,383, as compared with $128,032,343 for December, and $295,628,048 for January, 1931.


NUMBER OF UNITS IN THOUSANDS
20
15
10
5
0
TOTAL MECHANICAL DRAFT
NATURAL DRAFT
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1929
1930
1931

Number of domestic and commercial oil burners shipped in the United States, 1929-31.

With the Manufacturers

New Protected Metal Developed at Mellon Institute

According to a recent research report, issued by Dr. A. W. Coffman, a new protected metal product, called Robertson-Bonded metal, has been developed at the Mellon Institute of Industrial Research, Pittsburgh, Pa. The product consists of a laminated felt and metal material, cemented to steel by the application of heat and pressure, the metal being the adhesive. This felt coating can then be saturated with any material selected to resist whatever corrosive action the steel is to be subjected to.

It is said that the material can be successfully formed in such operations as shearing, bending, corrugating, rolling, and mild drawing, without destroying the adhesion between the felt and steel. The process is expected to find application in the building industry, and in pipe line protection, among other uses.

New Plan Offers Homes Through Lumber Dealers

C. E. Stedman, vice-president of Celotex Co., Chicago, Ill., advocates a plan whereby a man, desiring to purchase a home, can simply select the one he wants from the lumber dealer's display.

This proposed plan, which would enable the 20,000 lumber dealers of the country to sell home construction and stimulate the building industry, would make selection and buying easy for the future homeowner, as he will know the exact price of each model and the financing terms available.

Celotex Company is supplying each dealer with pictures, detailed drawings and specifications of houses of various sizes designed by well-known architects.

Improving Dealer Accounting Practices

How manufacturers and wholesalers are helping their retailers to put their accounting methods on a sound and accurate basis, is the subject of a report that has just been published by the Policyholders Service Bureau of the Metropolitan Life Insurance Company, entitled "Improving Dealer Accounting Practices."

Among the varied aspects of the movement that are dealt with in the report are the types of businesses rendering an accounting service, nature and extent of the help given, accounting manuals, basis on which the service is rendered, methods of securing dealer participation, and a description of results secured by a number of companies. Twenty-five firms contributed their experience.

Interested executives may receive a copy of the booklet by addressing the Policyholders Service Bureau, Metropolitan Life Insurance Co., New York.

Bennett Fireplace Corp., Norwich, N. Y., is offering a folio of fireplace designs to architects, contractors, and prospective home builders. The folio contains twenty distinctive ideas for fireplaces, to suit a variety of situations and styles of architecture, executed in pencil drawings. Twenty-one loose-leaf pages, 8¼ in. x 11¾ in.

American Air Filter Co., Inc., Louisville, Ky., has announced the publication of Filtered Air, a non-technical booklet directed primarily to school boards, hospital boards, and executives specifying equipment for buildings. It is the first of a series planned to deal with the application of air filters. Fifteen pages, standard size.

The Ohio Electric Mfg. Co., 5900 Maurice Ave., Cleveland, Ohio, is distributing Bulletin 221, describing and illustrating special motor designs to meet unusual applications. Contains dimensional and other engineering data. Four pages, standard size.

Doherty-Brehm Company, which has moved its offices to 2144 North Ashland Ave., Evanston, Ill., announces the election of George Doherty as president to succeed Edward Brehm, who recently resigned.

The Boston Edison Company in its annual report states that it is now furnishing steam service to 173 customers. The gross income from steam sales amounted to $550,819, in 1931. During the year, 5658 ft. of underground steam mains, ranging in size from 4 in. to 16 in., were installed.

The Timken Silent Automatic Co., Detroit, Mich., and *Cleveland Steel Products Corp.*, Cleveland, Ohio, have grouped their rotary burner patents under the name Tim-Tor. The Tim-Tor group includes eight issued patents and thirty-five additional pending applications.

Pierce, Butler & Pierce Mfg. Corp., New York, has opened a new branch in Troy, N. Y., at River and Madison Streets, in charge of George H. Fox.

The American Rolling Mill Co., Middletown, Ohio, has published Armco Architectural Bulletin No. 7, covering 230 buildings in which Armco iron has been used in the ventilating and air conditioning systems.

The Ric-wiL Co., Union Trust Building, Cleveland, Ohio, has announced publication of its annual edition of Condensed and Tabulated Heating Rates of district heating utilities for the heating season of 1931-32.

Truscon Steel Co., Youngstown, Ohio, has issued a catalog on its product, Ferroclad structural panels. A table of heat transmission values for various wall constructions, a table of conductances for Ferroclad, and drawings of applications, are included. Standard size, 20 pages.

Detroit Stoker Co., Detroit, Mich., has appointed L. M. Hofstetter, district manager of its Baltimore office, with offices in the Hearst Tower Building.

Burke Electric Co., Erie, Pa., announces the appointment of Albert J. Walz as its distributor in the Chicago district. Mr. Walz is located at 205 West Wacker Drive. P. J. Burrill and J. L. Vergillio have been appointed general distributors

INSTRUMENTS for CONTROL of AIR CONDITIONING EQUIPMENT

AIR Conditioning Equipment is no better than its CONTROL instruments.

Because of the importance of exact control, and because its cost is such a small part of an investment in a system of Air Conditioning, the question is not "which control is the cheapest?," but "which is the most *Accurate* and *Dependable*?"

Users of Powers Control know that it is cheaper in the end to pay a little more for instruments of superior Accuracy and Dependability and always be satisfied, than to pay a little less and never be satisfied.

40 Years of Specialization in Temperature Control

CHICAGO: 2718 Greenview Ave. Offices in 43 Cities NEW YORK: 231 East 46th St.
TORONTO: 106 Lombard Street

THE POWERS REGULATOR COMPANY

With the Manufacturers

for northern Ohio, with offices at 942 Prospect Ave., Cleveland, Ohio.

Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago, Ill., has recently issued a new catalog describing its line of fans and blowers. The catalog is illustrated, and shows a variety of applications, and contains tabulations of engineering data. Forty-eight pages, standard size.

Frigidaire Corp., Dayton, Ohio, recently called a meeting of its 1300 company sales representatives, at the Hotel Waldorf-Astoria, in New York, to introduce the company's new air conditioning unit.

Barber-Colman Co., Rockford, Ill., has appointed R. K. Rothrock, 2204 Jefferson Ave., New Orleans, La., distributor of its equipment in Louisiana and Mississippi.

Commodore Heaters Corp., New York, announces that William Ehrlich, formerly New York manager of Trane Company, has been appointed its chief engineer.

Julian d'Este Co., Charlestown, Mass., has bought the patents and rights to the Waltham oil burner from the Waltham Oil Burner Corp., Waltham, Mass. The trade name Waltham will be retained by the purchaser.

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., will move manufacturing units of the Time-O-Stat Control Co., Elkhart, Ind., to Minneapolis. Time-O-Stat Control Company was acquired by Minneapolis-Honeywell Regulator Company about a year ago.

Sarco Co., New York, announces the formation of a company to manufacture its products in England. The new company, Spirax Mfg. Co., Ltd., has its headquarters in London.

Spencer Heater Co., Williamsport, Pa., has opened a boiler showroom at 96 Brookline Ave., Boston, Mass.

Payne Furnace & Supply Co., Beverly Hills, Calif., has appointed J. Lyle Vance manager of its wholesale sales.

Bonney Forge and Tool Works, Allentown, Pa., announces the following appointments: G. Fred Sherman, formerly assistant sales manager of Tube-Turns, as manager of sales of the forged fittings division; Ben Bush and Howard F. Grimes have been added to the sales staff of this division, Mr. Bush selling in the New York and Pennsylvania district, and Mr. Grimes selling in the middle west.

Barber-Colman Co., Rockford, Ill., has announced the appointment of the Brown Tool Co., 10465 Carnegie Ave., Cleveland, Ohio, as its distributor in the northern third of Ohio.

International Burners Corp., New York, announces the appointment of distributors in key cities, including Chicago, Boston, Baltimore and Washington, D. C.

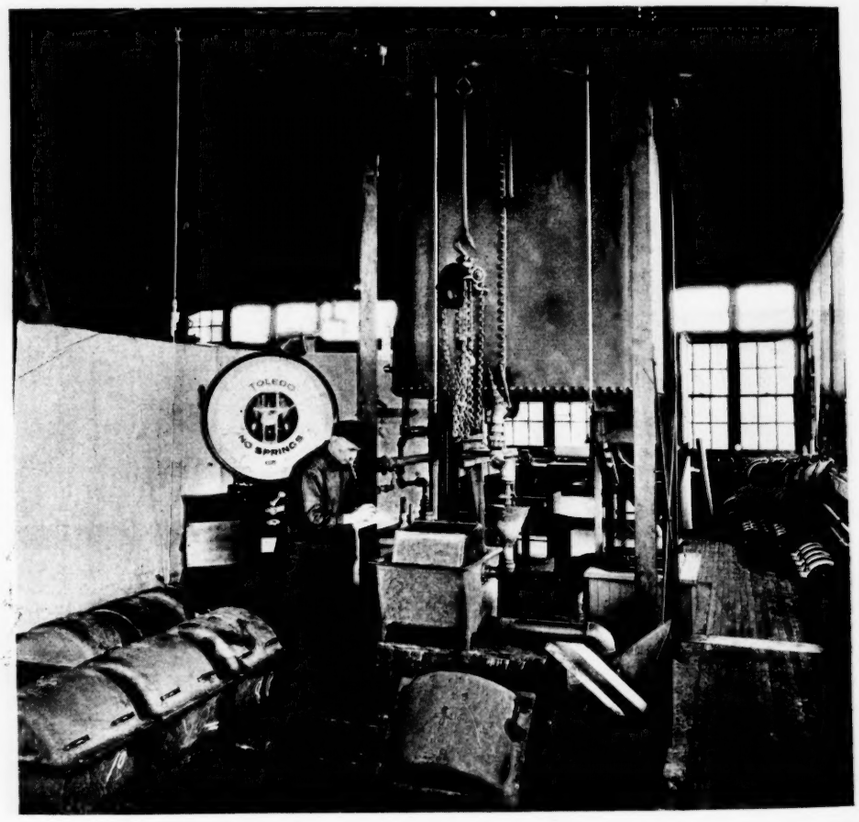
The Marine Oil Co., Inwood, L. I., New York, oil distributor, has bought the Tabor Mfg. Co., Philadelphia, Pa., and will manufacture and market the Tabor pressure atomizing burner. The Tabor Company, organized about four years ago, has been under the managership of J. Lee Allen. Mr. Allen now is interested in the General Heat & Power Corp., New York, manufacturers of the Ghapco special oil-fired boiler-burner unit.

Chelva Heat Inc., 56 Earl St., Newark, N. J., has recently been organized to manufacture and distribute electrical heating equipment. Officers of the company are: president, J. R. Wilson, formerly of Crocker-Wheeler Mfg. Co., vice-president, L. T. M. Ralston, consulting engineer.

Economy Equipment Co., Inc., 6835 Wentworth Ave., Chicago, Ill., has issued two bulletins, one on air conditioning equipment for candy manufacturing plants, and the other devoted to similar equipment for biscuit manufacturers.

Titusville Iron Works Co., Titusville, Pa., has appointed Gilbert Howe Gleason & Co., Boston, Mass., sole representative in Maine, New Hampshire, Vermont, Massachusetts, Rhode Island and part of Connecticut.

Barber-Colman Co., Rockford, Ill., has recently appointed Park S. Hedley Co., Buffalo, N. Y., as its distributor in western New York and northwestern Pennsylvania.



Testing rotary meters at the plant of the American District Steam Co., North Tonawanda, N. Y.

A NEW TEMPLE OF HEALING INVITES THE SUN

LOS ANGELES COUNTY GENERAL HOSPITAL

Architect: Allied Architects, *Cons. Engr.:* E. L. Ellingwood, *Gen. Con.:* Weymouth C. Crowell, *Plumb. and Heat. Con.:* Howe Brothers. All of Los Angeles, California

ON a hill remote from the din and stress of the city, bathed by the sun and soft airs of a favored region, admirable for design, great in size and facilities, complete in every modern resource, the Los Angeles County General Hospital takes high rank among the marvelous institutions of its kind built in this country in recent years. Their like never was before in the world. For never had science and the arts reached a development to make them possible.

Only the best in design, construction and equipment could be thought fit to go into such a building for any use.

It is a matter of pride for the manufacturers of NATIONAL Pipe that in the Los Angeles County General Hospital, as in other noteworthy hospitals lately completed, the major tonnage of pipe was NATIONAL—

America's Standard Wrought Pipe

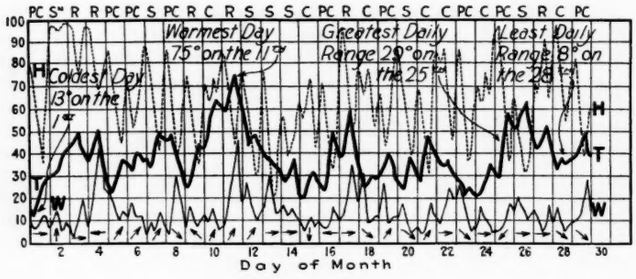
NATIONAL TUBE COMPANY, PITTSBURGH, PA.

Subsidiary of United States Steel Corporation

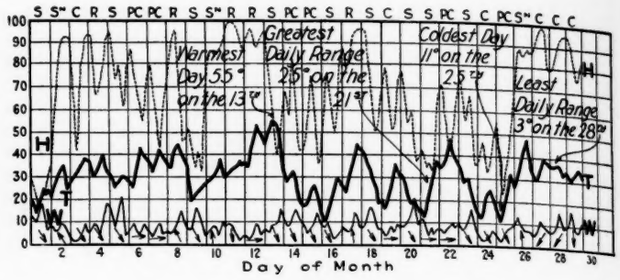
NATIONAL PIPE

The Weather

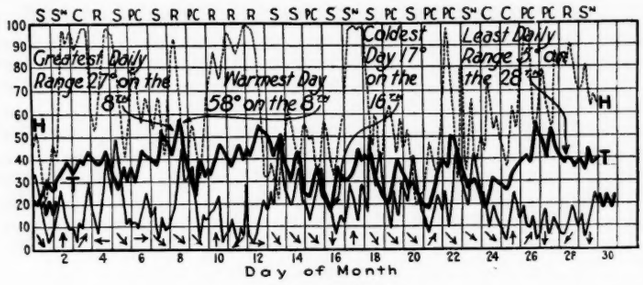
February, 1932


Warmest Day 75° on the 11th
Greatest Daily Range 29° on the 25th
Least Daily Range 8° on the 28th
Coldest Day 13° on the 1st
Day of Month

Pittsburgh

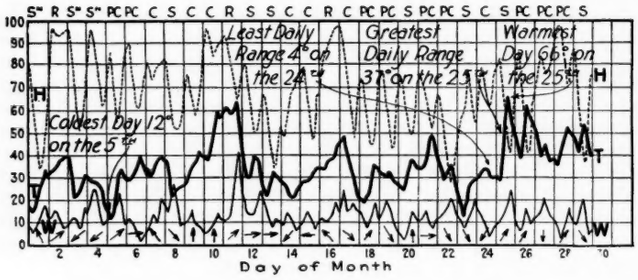

Greatest Daily Range 28° on the 21st
Warmest Day 55° on the 13th
Coldest Day 11° on the 25th
Least Daily Range 3° on the 28th
Day of Month

Boston

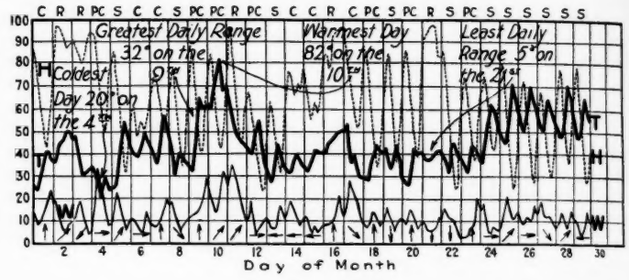

Greatest Daily Range 27° on the 8th
Warmest Day 58° on the 8th
Coldest Day 17° on the 16th
Least Daily Range 3° on the 28th
Day of Month

New York

(Hourly Observation of the Relative Humidity Plotted on this Chart)


Least Daily Range 4° on the 24th
Greatest Daily Range 31° on the 25th
Warmest Day 66° on the 25th
Coldest Day 12° on the 5th
Day of Month

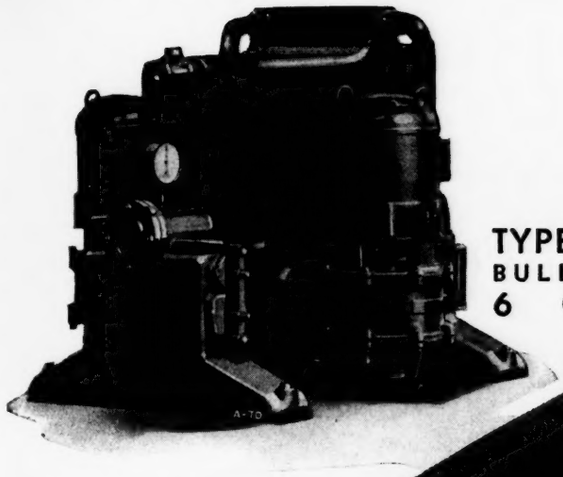
Chicago


Greatest Daily Range 32° on the 9th
Warmest Day 82° on the 10th
Least Daily Range 5° on the 21st
Coldest Day 20° on the 4th
Day of Month

St. Louis

	New York	Boston	Pittsburgh	Chicago	St. Louis
Highest temperature, deg. F.	58	55	75	66	82
Date of highest temperature	8	13	11	25	10
Lowest temperature, deg. F.	17	11	13	12	20
Date of lowest temperature	16	25	1	5	4
Greatest daily range, deg. F.	27	25	29	37	32
Date of greatest daily range	8	21	25	25	9
Least daily range, deg. F.	5	3	8	4	5
Date of least daily range	28	28	28	24	21
Mean temperature for month, deg. F.	36.0	30.6	38.2	35.0	44.6
Normal mean temperature for month, deg. F.	31.3	28.9	32.3	26.4	34.8
Total precipitation, this month, inches	2.38	1.74	0.82	1.21	1.59
Total snowfall, this month, inches	2.2	10.8	1.5	5.6	Trace
Normal precipitation, this month, inches	3.82	3.50	2.70	2.19	2.63
Total wind movement, this month, miles	11,354	5,348	8,275	8,347	8,198
Average hourly wind velocity, miles	16.3	7.7	11.9	12.0	11.8
Prevailing direction of wind	N.W.	N.W.	W	S.W.	S.W.
Number of clear days	6	8	4	7	9
Number of partly cloudy days	12	8	8	11	9
Number of cloudy days	11	13	17	11	11
Number of days with precipitation	13	9	11	6	6
Number of days with snowfall	4	5	1	3	None
Snow on ground, at end of month	None	None	None	None	None

Plotted from records especially compiled for HEATING AND VENTILATING by the United States Weather Bureau.
Heavy lines indicate temperatures in degrees F. Light lines indicate wind in miles per hour.
Broken lines indicate humidity in percentage from readings at 8 a. m., 12 m., and 8 p. m.
S—clear, PC—partly cloudy, C—cloudy, R—rain, Sn—snow. Arrows fly with prevailing directions of wind.



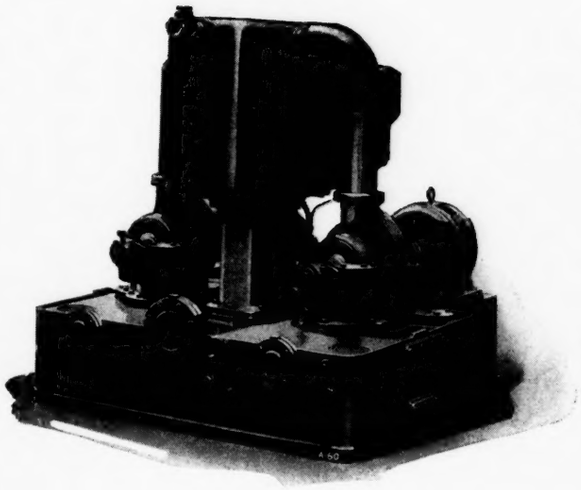
TYPE "E"
BULLETIN
6 0 0

1 *Vibrationless operation* becomes a reality with Ames Vacuum Heating Pumps because they run on the principle of continuous flow — a smooth rotary motion allowing of no pulsation shocks.

2 *Less power is consumed* by Ames Pumps because of the airtight and leakproof design and construction, which permit operation of the motors only when there is a reduction in vacuum due to conditions in the heating system.

3 *Vacuum breakdown tests,* with pump shut down and inlet valve closed, show that with an initial 26-inch vacuum a reduction of only 3 inches occurs after a 5-hour period.

4 *Perfection of details,* such as flexible couplings, integral strainer, cover assembly, etc., is one of the qualities that makes AMES the pump of distinction.



TYPE "F"
BULLETIN
7 0 0

AMES PUMP COMPANY, Inc.
30 Church Street **New York, N. Y.**
DIVISION OF AMERICAN LOCOMOTIVE COMPANY
Representatives in All Principal Cities
Manufactured and Sold in Canada by Montreal Locomotive Works, Ltd.

Degree Days and Unit Fuel Consumption in Typical Cities

February, 1932

UNIT fuel consumption figures given below must be corrected for efficiency, heat content of fuel other than that listed below, for radiation emitting other than 240 B.t.u. per hr., and for radiation calculated on a basis other than zero outside to 70° inside.

Coal is assumed as having a heat content of 12,000 B.t.u. per lb., gas, 1000 B.t.u. per cu. ft., and oil, 140,000 B.t.u. per gal. To correct for other heating values, multiply the fuel consumption listed under the charts by the standard heat content just listed, and divide by the heat content of the fuel actually being used in the installation being calculated.

For radiation installed for any other outside temperature than zero, multiply the fuel consumption given under the charts by 70°, divided by the quantity (70 minus the outside temperature used).

To correct for efficiency, divide the fuel consumption by the efficiency of the heating installation.

For water radiation, multiply the fuel consumption which is given for steam radiation by ⅝.

	New York	Seattle	San Francisco	Chicago	Denver	Boston	St. Louis	Pittsburgh	Minneapolis
Degree days	840	703	393	871	729	997	593	774	1256
Total degree days since September 1	2889	3442	2159	3386	4008	3457	2497	2950	4887
Lb. of coal per sq. ft. of radiation for February	6.720	5.624	3.144	6.968	5.832	7.976	4.744	6.192	10.048
Gal. of oil per sq. ft. of radiation for February	0.572	0.482	0.269	0.597	0.500	0.683	0.407	0.531	0.861
Cu. ft. of gas per sq. ft. of radiation for February	80.64	67.49	37.73	83.62	69.98	95.71	56.93	74.30	120.58

	Los Angeles	Baltimore	Philadelphia	New Orleans	Atlanta	Cleveland	Cincinnati	Detroit
Degree days	269	645	742	55	346	847	651	929
Total degree days since September 1	1178	2239	2453	404	1476	3088	2687	3495
Lb. of coal per sq. ft. of radiation for February	2.152	5.160	5.936	0.440	2.768	6.776	5.208	7.432
Gal. of oil per sq. ft. of radiation for February	0.184	0.442	0.509	0.038	0.237	0.581	0.446	0.637
Cu. ft. of gas per sq. ft. of radiation for February	25.82	61.92	71.23	5.28	33.22	81.31	62.50	89.18

	Buffalo	Birmingham	Indianapolis	Memphis	Des Moines	Kansas City	Louisville	Galveston
Degree days	981	259	738	329	960	668	559	61
Total degree days since September 1	3632	1215	2929	1569	4004	2978	2332	586
Lb. of coal per sq. ft. of radiation for February	7.848	2.072	5.904	2.632	7.680	5.344	4.472	0.488
Gal. of oil per sq. ft. of radiation for February	0.673	0.178	0.506	0.226	0.758	0.458	0.383	0.042
Cu. ft. of gas per sq. ft. of radiation for February	94.18	24.86	70.85	31.58	92.16	64.13	53.66	5.856

Fuel consumption figures must be corrected for local conditions as explained above.

Heating and Ventilating

THIS MONTH

Making the Rounds with a Service Man
V. D. Milliken

• • •

Regenerative Cooling for Hot Dry Climates
K. P. Brace

• • •

Use of Steam Jets for Smoke Abatement
Arthur C. Stern

• • •

ROCKEFELLER CENTER
Part I. The Project
Part II. Heating and Ventilating of Building One

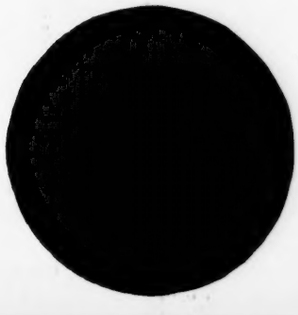
• • •

Air Binding in a Vacuum System
The Trouble Engineer

• • •

Dehumidifying Air with Calcium Chloride
S. B. Heath

• • •

Air Conditioning—Part XIX
Fabrication and Erection of Ductwork

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